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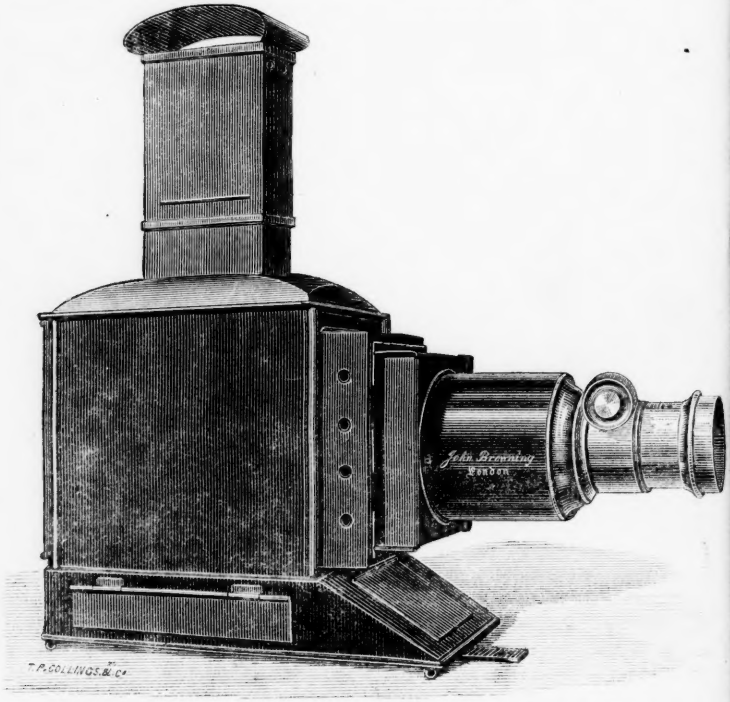

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THE MONTHLY

JOURNAL OF SCIENCE.

NOVEMBER, 1879.

I. LEGENDS OF SEPULCHRAL AND PERPETUAL LAMPS.

By Prof. H. CARRINGTON BOLTON.

EVERY science and every art appears to have had, at some period in its history, aims and aspirations of an unphilosophical and superstitious character; every branch of learning has had its infatuated enthusiasts working at unachievable projects and striving to reach unattainable goals. In astronomy, clever and learned men endeavoured to foretell the fate of mankind by a study of the stars; in mechanics they sought for perpetual motion: in mathematics, for the quadrature of the circle; in medical art for a universal panacea and an elixir of life; and chemical science was for many centuries a fertile field for speculations no less chimerical and unsubstantial.

The extraordinary delusions of the alchemists have been summarised by Wiegleb, a German chemist of the last century, in the following words:—"At one time they turned their attention to the production of pearls and precious stones; at another to the fixation of ordinary mercury, and hence to its extraction from natural metals; some sought to transform water into vinegar, others eneavoured to make glass flexible and malleable. They sought also to prepare for the physician the much-needed elixir of life, to transform common salt into saltpetre, to prepare a universal solvent, *to discover the means of causing lamps to burn perpetually*, to reproduce plants and animals from their ashes, and even to effect the resurrection of the dead! Besides these chimerical pursuits, the favourite and most enticing of all was the transmutation of the common or base metals into silver and gold." *

* WIEGLEB, Hist. Krit. Untersuch. d. Alchemie. Weimar, 1777. 12mo.

The belief in ever-burning lamps mentioned by Wiegleb is not unfrequently alluded to in prose and poetry, yet detailed and exact information on this point is to be had only by patient research. Many volumes have been written on the history of chemistry, and on alchemy, narrating the fanciful views and arduous labours of the would-be transmuters of the base metals, but they seldom make reference to the sepulchral and perpetual lamps.

During the sixteenth and seventeenth centuries a belief in the actual existence of ever-burning lamps seems to have been very real and widely prevailing. Many learned writers maintained that the ancients were acquainted with the preparation of a combustible fluid, which, while burning and giving out light, diminished not in quantity and potency. Lamps supplied with this marvellous liquid were placed in tombs by the ancient Romans, and continued burning until some ruthless explorer desecrated the subterranean places of burial and allowed air to enter, whereupon the flame flickered and shortly expired. These astonishing lamps "burned the most brightly where there was most want of air, and were always extinguished by the immission of external air."—(Dr. Plot.)

To discover the secret of preparing this combustible yet inconsumable liquid was one of the alchemist's dreams; in their figurative language they endeavoured to "concentrate the four elements, and to make therefrom a wonder-working essence."—(Kriegsmann.) The material upon which their operations were conducted, and in which they placed great reliance, was fine gold; this, they said, resolved by hermetic methods into a "clear liquid," supplied, by its "incombustible oiliness," the perpetual light. Some authors describe the liquid in question as an "extract of the elements prepared with great labour, and possessing the property, when provided with a suitable ferment of silver or gold, of forming the white or red tincture capable of transmuting the base metals." But without the ferment it nourished the ever-burning lamps, and on account of its exceeding costliness was consecrated to the mythological divinity Pluto." Such is the description of this liquid contained in a rare and quaint little 16mo., entitled "Taaut," written by one Wilhelm Christoph Kriegsmann, and published at Frankfurt in 1665 (page 65 of Notes).

The alchemists did not, however, always employ such enigmatical and obscure language when writing of this mysterious liquid. Trithemius—a learned abbot of the fifteenth century, who found leisure amid his Benedictine duties to

write works on theology, history, philosophy, and alchemy—gives two receipts for making the inexhaustible oil: one of these reads as follows:—

"Mix four ounces of sulphur and four ounces of alum, sublime them, and convert them into flowers. Take two and one-half ounces of these flowers, with half an ounce of borax and Venetian crystal, and pulverise the whole in a glass mortar. Put the powder into a phial, and, having poured into it spirit of wine four times rectified, cause it to digest. Pour off the spirit of wine, and, having added some new, repeat the operation three or four times, until the sulphur runs on hot plates of brass without smoke, like wax. You must then prepare a proper wick, which may be done in the following manner: take filaments of mineral flax of the length of the finger, form them into a packet half as thick as the finger, and tie them with a white silk thread. The wick being thus arranged, cover it with the sulphur prepared as before described, and immerse it in the sulphur in a vessel of Venetian glass. Place the whole upon a sand-bath for twenty-four hours, so that you may always see the sulphur boil, and the wick being by these means well penetrated and impregnated with that aliment, put it into a small glass with a wide mouth. Then fill this vessel with the prepared sulphur and place it in warm sand, that the sulphur may melt and surround the wick. If it be then kindled it will burn with a perpetual flame."*

It is hardly necessary to add that the process, described with so much care, would prove very unsatisfactory to any curious investigator.

The alchemists also claimed that an inconsumable oil could be obtained by treating gold with oil of vitriol, and they called the product *oleum vitrioli aurificatum*. Other receipts are given by the Jesuit Athanasius Kircher, and will be found by the curious in his "Mundus Subterraneus."†

The belief in perpetual lamps was sustained and diffused by the publication of many legends, which appear to have been freely accepted by a credulous people, notwithstanding their highly improbable character and the slender basis of truth on which they were founded. One of the most famous and oft-quoted legends establishing this superstitious belief was that of the tomb of Tulliola. In the pontificate of Paul III. (1534—1549), the same who convoked the Council of Trent, a tomb was opened, at Rome, which contained the

* Trithemius, Tractatus de Lapide Philosophorum. 1611, 8vo.
† Vol. ii., Lib. 8, Sect. 3, De Asbesto, &c.

body of a young woman in a remarkable state of preservation. Her flesh was uncorrupted,* and her tresses were still bound with a small plate of gold curiously chased and enamelled. A burning lamp hanging in the vault was extinguished as soon as the air entered. On the walls was carved the inscription "*Tulliola filiæ meæ*," which was thought to refer to Tulliola, the daughter of Cicero, whose death he laments in his letters to Servius Sulpicius.† One authority states that the lamp burned several hours after opening the tomb, though it must have been closed more than fifteen hundred years. This legend was the subject of much comment. Montfaucon,‡ the eminent French antiquary and philologist, repudiates the story, and maintains that it is merely the revival of an older tale concerning the discovery of an uncorrupted body, in March, 1485, related by Etienne de Infestura and Alexander ab Alexandro. The latter describes the marvellously perfect preservation of the remains, and adds—"To see the body one would have have thought it interred but a short time; there was no inscription, though Pomponius thought it to be the body of Tulliola, daughter of Cicero, or that of Priscilla, wife of Abascantius."

Another legend, which supplied partisans with one of their strongest arguments, was that of the Lamp of Olybius. In the year 1500 some peasants, digging the earth to a considerable depth, near Padua, discovered a tomb containing lighted lamps, one of silver and the other of gold; or, according to another authority, there was but one lamp, placed in an urn between two phials, one filled with liquid gold and the other with liquid silver, by virtue of which the light had been maintained since the days of the Romans. According to inscriptions§ on the urns the lamp had been prepared with great labour by Maximus Olybius. Representations of the two vases, with their inscriptions, are given in Kriegsmann's "Taaut," and in several less rare works.‖ Licetus,

* Perhaps converted into adipocere (?).

† Ad Familiares, iv., 6.

‡ L'Antiquité Expliquée. Paris, 1719.

§ *On the smaller urn*:—Abite hinc pessimi fures! Vos quid voltis vestris cum occulis emissitiis? Abite hinc vestro cum Mercurio petasato caduceatoque. Maximus maximo donum Plutoni, hoc sacrum facit.

On the larger urn;—

"Plutoni sacrum munus ne attingite fures!
Ignotum est vobis hoc quod in urna latet;
Namque elementa gravi clausit digesta labore
Vase sub hoc Modico Maximus Olybius.
Adsit fœcundo custos sibi copia cornu,
Ne pretium tanti depereat laticis.

‖ *See* PETRI AFRIANI, Incriptionibus, p. 337; also LICETUS, FERRARI, and MONTFAUCON,

of whom more hereafter, gives a letter of Maturantius, who tells his friend Alphenus that "Both the urns and the lamps and the phials have fallen into my hands, and are now in my possession. If you saw them you would be astonished. I would not part with them for one thousand crowns of gold." Two similar sepulchral lamps are to be seen in the Museum of Rarities at Leyden.

Many other equally credible narratives were current in the sixteenth and seventeenth centuries. At the time of the suppression of the monasteries by King Henry VIII. (1537) a tomb was opened containing a lamp which had been burning at least twelve hundred years: the authority of Cassidiorus was quoted, who says he himself made perpetual lamps for the use of the monks in his monastery at Viviers (about 500 A.D.). Reference was also made to the lamp of Pallas, son of Evander, whose brave deeds were sung by Virgil: this lamp was found at Rome about 800 A.D., and must have burned nearly 2000 years. Even St. Augustine, the most illustrious and holy Father of the Church, was claimed, by partisans of these traditions, as testifying to their truth. St. Augustine, mentioning the lamp in the Temple of Venus, says it "burned perpetually, and the flame adhered so strongly to the combustible matter that neither wind, rain, nor tempests could extinguish it, though continually exposed to the inclemency of the seasons." St. Augustine attempts to explain the marvel, and conjectures that the incombustible wick was made of asbestos, but that the inexhaustible aliment was the work of demons, who wrought the infernal miracle in order to blind the pagans more completely, and to attach them to the infamous deity worshipped in that temple.

The famous chemist Glauber refers to these miraculous lamps in his brief essay entitled "Book of Fires" (*Libellus Ignium*). He writes of a lamp "which, being closed up in a glass, may be made to burn continually by its own virtue, and give light without any other help." He explains the admitted fact that when the "secret fire" is "touched by the least air it extinguisheth and goeth out," by the suggestion that "the fire is appropriated to the Elemental Air," and hath its "own air in itself." Glauber, who was always ready to turn chemical discoveries to medical purposes, writes of this lamp that it may be "very available to those who, by reason of continual weakness, are forced to lie much upon their beds," and that it may be "kept continually burning in their bed-chamber, not only because of its clear shining light which doth neither smoak nor scent, like all

other combustible lights, which scent is very prejudicial to the sick as well as to the healthy." *

Even in the eighteenth century we find anecdotes of these ever-burning lamps, clothed with new adornments and skilfully adapted to the later epoch. One of the most entertaining of these legends is that of Rosencreutz, the founder of the mysterious fraternity known as the Rosicrucians. The narrative runs as follows:—A certain person having occasion to dig somewhat deep in the ground, where the philosopher Rosencreutz lay interred, met with a small door having a wall on each side of it. His curiosity, and the hope of finding some hidden treasure, soon prompted him to force open the door. He was immediately surprised by a sudden blaze of light, and discovered a very fair vault. At the upper end of it was a statue of a man in armour, sitting by a table and leaning on his left arm. He held a truncheon in his right hand, and had a lamp burning before him. The man had no sooner set one foot within the vault than the statue, erecting itself from its leaning posture, stood bolt upright, and, upon the fellow advancing another step, lifted up the truncheon in his right hand. The man still ventured a third step, when the statue with a furious blow broke the lamp into a thousand pieces, and left his guest in sudden darkness. Upon the report of this adventure the country people came with lights to the sepulchre, and discovered that the statue, which was made of brass, was nothing more than a piece of clockwork; that the floor of the vault was all loose and underlaid with several springs, which upon any man's treading naturally produced that which had happened. Rosicrucius, said his disciples, made use of this method to show to the world that he had re-invented the ever-burning lamps of the ancients, though he was resolved no one should reap any advantage from the discovery."†

The Comte de Résie, in his curious "Histoire et Traité des Sciences Occultes,"‡ gives a brief account of the sepulchral lamps, and adds the following narrative:—In the reign of St. Louis (1226—1270) there lived in Paris a certain Rabbi named Jechiel, who was regarded by the Jews as a saint and by Christians as a sorcerer. He possessed a lamp which gave out light equal to daylight in brilliancy, which required no oil, and burned unceasingly. But what is more singular still, when honest tradesmen or people of quality came at night to knock at the door, his lamp shone brightly

* Glauber's Works. London, 1689. Part II., p. 216.
† Spectator, No. 379, May 15, 1712, written by Eustace Budgell.
‡ Vol. ii., p. 67, 1857.

as usual, and the Rabbi gave his friendly guests an entrance; but whenever impostors or persons of evil intent presented themselves at the door, the lamp grew visibly pale, and the Jew took care to fasten the door against the intruder.

The latter half of the seventeenth century witnessed a considerable controversy on the subject of perpetual lamps. On the affirmative side of the question we fine the names of the Abbot Trithemius, already mentioned; John Baptist Porta, the eminent Italian physicist, the same who invented the camera obscura ("Magiæ Naturalis," Libri xx., 1558); the celebrated Italian engraver and painter, Pietro Santi Bartoli ("Le antiche Lucerne, &c.," Roma, 1691, fol.); the German antiquary, Lorenz Beger ("Lucerne, vet. sep. Berol.," 1702); the learned Jesuit, Martin Antoine Delrio ("Essay on Magic," 1599), who attributed the lamps to magic skill; and Fortunius Licetus, the most credulous and erudite of all. On the negative side of the question are arrayed the names of Vigneul-Marville, a French Carthusian monk (1699); the learned Jesuit, Athanasius Kircher, whose "Mundus Subterraneus" has been already quoted; the Italian antiquary and Professor of Philosophy, Ottavio Ferrari ("Dissertatio de Veterum Lucernis," Padua, 1684, 4to., in Grævius's "Thesaurus Antiq. Ital."); the Italian ecclesiastic, Paolo Aresi, Bishop of Tortona ("Sacred Emblems," 1613); the English naturalist and antiquary, Robert Plot ("Phil. Trans.," Abr. III., p. 100, 1684; the German chemist, Libavius ("Comment. Alchem.," Part II., Lib. ii., Cap. x., 1595); Buonamici, an Italian *litterateur;* Fabricius; Montucla; and many others.

To detail all the points for and against the existence of perpetual lamps made by these writers does not come within the scope of this essay. One of the most earnest supporters of these fables, Fortunius Licetus, deserves a somewhat lengthier notice.

Fortunius Licetus was born in the State of Genoa, October 3rd, 1577. He was the son of a physician, and, having received a liberal education in medicine and philosophy, became professor of these departments of learning at the University of Padua. After holding these chairs for twenty-five years the rival University of Pisa secured his services by a tempting offer; but nine years later, a vacancy occurring at Padua, he returned to his former position, and held it until his death in 1657. Licetus was a voluminous author, writing fifty treatises on medical, moral, philosophical, antiquarian, and historical subjects, which were distinguished for their erudition, though he displayed little

acuteness in research or originality of conception. His treatise "De Monstrorum Causis" (1668) abounds with instances of his credulity and with the superstitions and fables of his predecessors. Of all his works none is more celebrated than his treatise on the Sepulchral and Perpetual Lamps of the Ancients ("De Lucernis Antiquorum reconditis," Venet., 1652). This work, of 640 pages in quarto, is written expressly to prove the truth of the traditions concerning sepulchral lamps. The author accumulates a great number of witnesses, ancient and modern, quoting legends of Merlin, Porta, Scardeonius, and many others. The work is abundantly illustrated with engravings of the perpetual lamps, and forms a notable example of misplaced erudition and credulity. In his first book Licetus mentions thirty instances of perpetual lamps, including those connected with the mysteries of the Delphic Oracle, the ceremonies of Jupiter Ammon, and of the Vestal Virgins. The lamp of Demosthenes, which burned in the Temple of Minerva at Athens, also furnished him with a proof of the possibility of an inextinguishable fire. Licetus also relates the testimony of Jacobonus, author of the "Book of the House of Cesi," who mentions several persons who had seen these lamps still burning. He confidently relies on the testimony of such an unreliable author as Pausanias (175 A.D.), who speaks of a golden lamp, in the Temple of Minerva, which, when once filled with oil, burned a whole year without replenishing—a marvel which he attributed to the nature of the wick. Licetus refers to the statement of Plutarch, who relates that Cleombrotus, the Lacedemonian, visited the Temple of Jupiter Ammon, and saw a lamp which the priests said burned continually without oil.

Vigneul-Marville, writing of Licetus's work, very justly remarks that in it "Licetus exhausts all the resources at his command, but after all does not inform us of what we most want to know, viz., the secret of these perpetual lamps.

Many endeavours have been made by modern authors to account for the persistence of this belief by reference to natural causes. Montfaucon remarks no one doubts that burning lamps were placed in tombs by the ancients, and gives the following inscription from a tomb at Salerno:—"Adieu Septima; may the earth lie lightly upon you; may a golden oil cover the ashes of him who placed in this tomb a burning lamp."*

* "Have Septima, sit tibi terra levis quisque huic tumulo posuit ardente lucernam illius cineres aurea terra tegat."

Certain writers suggest that the imperishable wicks may have been made of asbestos, or "salamander's wool" as it was called, but they encounter great difficulty in the matter of the "indestructible aliment." Vigneul-Marville ascribes the flames to the "fat and gross vapours engendered by the corruption of dead bodies and enkindled by the torches used in opening a tomb." Dr. Robert Plot, "Director of Experiments to the Philosophical Society of Oxford," read a paper before the Society, in 1684, in which he narrates experiments made to test the value of asbestos for lamp-wicks. He concludes that this material may have been used in the sepulchral lamps, and to account for the inexhaustible oil discourses on a spring of liquid bitumen, or naphtha, such as occurs in Shropshire: a similar suggestion was made by Athanasius Kircher as early as 1665 ("Mundus Subt.," *loc. cit.*). Other writers conjecture that the lights found in the tombs were of phosphorus—meaning thereby not the modern chemical element of this name, but the so-called "Bologna stone," which shines in the dark. The elder Disraeli briefly notices these remarkable legends in his "Curiosities of Literature," and points out the necessity of the oxygen of the atmosphere to ordinary combustion; he considers this fact in itself a sufficient refutation of these singular traditions.

II. NATIONAL SCIENTIFIC APPOINTMENTS.

MANY well-informed people, including not a few of those who hover round the outskirts of the scientific world, have but very vague notions concerning the manner in which many of our scientific officials are selected. We have heard the question asked whether appointments of this nature were obtained by influence, by examination, or, *rebus gestis*, by discoveries made and researches carried out. In consideration of our national cram-worship, it need scarcely have been doubted that we should, with rare exceptions, hold fast to the worst of all possible methods, that of competitive examination—a system which is year by year lowering our national position in the scientific world.

XUM

Facts have, indeed, lately come to light which might render all further argument needless if "cram," like many other absurdities, had not ninetyfold the "nine lives" which the popular proverb assigns to cats. The "Chemical News," in its "Students' Number" for the session 1879-80, informs us, on the authority of Prof. Huxley, that "not so very long ago a certain student, who had never handled a dissecting-knife, carried off the B.A. prize as well as honours in Animal Physiology by dint of an excellent memory, and is now a Government clerk, whilst a contemporary of his who in the same year carried off prizes and honours in Chemistry, without having ever cleaned a test-tube in his life, is now one of our leading musical composers and critics." What man of ordinary common sense can fail to see the absurdities which in these two cases lie piled up, layer upon layer? Or what unprejudiced mind can require further evidence for the necessity of a great and a total change?

An official document has lately been issued, announcing that "open competitive examinations" will shortly be held for two scientific appointments, viz., that of Assistant-Keeper in the South Kensington Museum (Science Branch), and that of Assistant Naturalist in the Natural-History Department of the Dublin Museum of Science and Art. The process consists of two parts. There is a preliminary scrutiny in hand-writing, orthography, arithmetic, English composition, and translation from Latin, French, or German into English. Without satisfactory proficiency be shown in all these subjects the candidate is allowed to proceed no farther. If successful, he is then admitted to the competitive ordeal itself, consisting of an "obligatory" and an "optional" branch. The former comprises in any case elementary mathematics, in which 500 marks are obtainable, and "any two of the seven following subjects: inorganic chemistry, which may count for 500 marks; organic chemistry, for 250; physics, for 750; zoology, 500; botany, 500; geology and mineralogy, 500; physiology, 500; and drawing, 500."

The "optional" department embraces any of the above seven subjects which the candidate has not selected as obligatory, and in addition any of the following:—"Higher mathematics (pure), 1000; theoretical mechanics, 500; applied mechanics, 500; French, 500; German, 500; Latin, 400; Italian, 400; Greek, 400; and English History, 400."

Having expressed our gratification that the examinees are not required to be "up" in heraldry, international law, book-keeping by double entry, Mexican archæo-

logy, &c., we may meditate sadly not so much on the mere "stiffness" of the examination as on its irrelevant character. From the remark that "Candidates for the situation of Assistant-Naturalist must pass in Zoology," we may safely infer that the duties of the post will mainly consist in the application of a thorough knowledge of the animal kingdom, and consequently that the man wanted must be above all things a zoologist. Yet the highest number of marks possible in this science is a poor 500 out of a maximum total of 9100, or not quite 6 per cent! Hence there is absolutely no safeguard that the best zoologist will be appointed! Neither botany nor even physiology is, by some strange oversight, demanded as essential. Hence it is quite conceivable that a man ignorant of these two branches of science, and endowed with a mere smattering of zoology, may still—if well versed in mathematics, physics, and in languages—completely swamp his rivals and win the prize. On the other hand, a biologist, "pure simple," a thorough specialist who has concentrated his whole attention and devoted his whole time to the study of organic life, is almost of necessity excluded. Suppose such a one selects as his two obligatory subjects zoology and physiology, and as an optional subject botany, and that in all three—as well as in elementary mathematics, which is inevitable—he gains the maximum number possible, or 500 marks in each; his total number will then be only 2000. On the other hand, let a competitor take 500 marks in elementary mathematics, 750 in physics, 250 in zoology, 1000 in pure mathematics, 500 each in theoretical and in applied mechanics, and 400 each in Greek and Latin, he achieves a total of 4300, and wins in honours. The true biologist is beaten in virtue, we had almost said, of his very superiority in his own department, or at least in virtue of that very concentration of thought and attention without which true greatness in any science is out of the question.

Another peculiar feature of these regulations is that the "optional" list, if taken in the gross, might possibly lead to a greater number of marks than the subjects in the "obligatory" list, even if the whole of them were taken up. To us it seems self-contradictory to admit that a science or a branch of knowledge is non-essential by placing it in an optional list, and yet to reward proficiency in it more highly than in the branches recognised as obligatory.

We may further point out certain omissions: the history of science, and especially of organic science, would be

assuredly more to the purpose than English history. Animal geography, based as a matter of course upon physical geography, would also have been a useful feature. But these subjects seem to have escaped the notice of the Science and Art Department, or to have been crowded out by less relevant matter.

In what manner the examination will be conducted it does not, of course, appear. It is possible that the practical knowledge of candidates will be carefully weighed, and will stand them in more stead than any amount of mere words —that, *e.g.*, in zoology they will be called upon to name, or at least to refer to the correct order and family, specimens placed before them assigning grounds for such classification. But it is, on the other hand, possible that the whole affair will resolve itself into a question of verbal memory, and that the candidate who from his own mental emptiness most eagerly absorbs and most glibly reproduces the views of others will win the day.

These considerations naturally remind us that the "Regulations" hold out neither inducement nor reward for research. We might reasonably expect that in such a case original observations or experimental results might, according to their value, count for hundreds, or even thousands of marks, and if of pre-eminent merit might be held to decide the contest irrespective of all other points. But not so; investigations, however successful, and discoveries, however brilliant, count here absolutely for nothing, whether in the obligatory or in the optional department. Their very possibility is not taken into account, and their production would, we fear, be looked upon as little better than contempt of court. How many of the world's greatest naturalists would escape being ignominiously "plucked" if pitted, under such regulations, against candidates possessing an excellent verbal memory and accustomed to the "cramming" process? We have met with eminent men of science who admit that they would utterly fail if examined in their own published researches against men of this stamp.

The very root of the cramming system lies in the strange circumstance that the division of labour, so widely and so usefully recognised in the industrial arts, should still be deemed inapplicable in the sciences, and should even, in some influential quarters, be regarded as rank heresy. Ages ago the wise saw "Jack of all trades and master of none" was understood and acted upon in the practical world. But we still will not recognise a man to be master of any science unless he can be, or seem to be, "Jack" of all. Suppose

we require a good ship-carpenter; we do not deem it needful to test his abilities in Turkey-red dyeing, or in glass-blowing, or in shoe-making. We are content that he shall be a specialist; we believe that all those powers of body or of mind which are required in his art can be best trained and developed in the acquirement and exercise of that very art. We do not fancy that a blacksmith requires to exercise his muscles by preliminary practice as an oarsman; we do not dream that a railway official or a pilot, in order to appreciate coloured signal-flags or fires, ought to serve an initiatory training in a dye-house. We go still further: we are apt to suspect the man who lays claim to proficiency in several arts or trades. We know that, however able and industrious a man may be, life is too short for the attainment of excellence in many different directions. We prefer the man whose whole time and whose individual energies have been concentrated on the subject we want, and, provided he gives us full satisfaction therein, we care little as to his "general culture." Even professional men are apt to suffer in the confidence of the public if it is known that they study any subject not strictly within the sphere of their more immediate duties. We have heard of a physician who had given much time and attention to the study of geology, and to the formation of a geological museum in the town where he lived. No one was, indeed, prepared to say that he had ever neglected a patient, or that he was out of the way if called for; still the people argued, roughly, but not in the main inaccurately, that he would have been a more able and successful physician had he not been a geologist, and he suffered in their opinion in consequence.

In scientific education, and in the preparation for certain professional careers, we do the very reverse of all that has just been described. We despise and reject the specialist, and call out for the "good man all round"—the man whose time and attention have been equally distributed. We forget that in these days each science has become so immense in extent that to keep up with the progress of discovery in one only branch is a task of no trifling magnitude, and that the Polyhistor of the day is a mere superficial trifler. To act on our present principle is not only to waste time, but to run the risk of acquiring habits of thought foreign to our immediate purpose. If a student has to learn to distinguish nicely between peculiarities of form, of texture, of colour, odour, and the like, he will not be greatly aided by turning his attention to words and abstractions.

So long as we insist upon general culture as obligatory,

"cram" will flourish, denounce it as we may. The only way to its extinction, and consequently to thoroughness, lies through specialism.

III. HABITS OF ANIMALS IN RELATION TO THE WEATHER.

By the Rev. S. BARBER, F.M.S.

THE habits of animals, and notably of the insect world, have for ages been admitted into the category of indicators of weather change. Much difficulty, however, has been found in interpreting these habits and movements,—a difficulty only to be overcome by long-continued, patient, and close observation of particular species. It is indeed somewhat remarkable that popular attention has been arrested, in this respect, by the habits of various species to which in a general way but little credit is given for intelligence, sagacity, or sensitiveness.

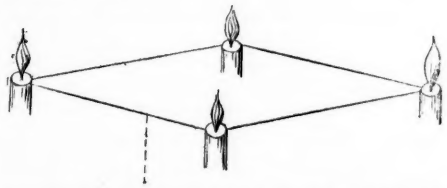
To associate the movements of ducks and geese (especially in a wild state) with weather changes in regard to rain and floods, which affect their habitations and supply of food, seems natural enough; but we find also such animals as the ram, the pig, and other thick-skinned creatures recognised as prophetical in weather lore and popular tradition. There is something taking in the notion of an astronomer gaining information of the approaching storm from the wagging of a ram's tail; and those whose occupation entails respect for, and attention to, the animal world, are often disposed to attribute to dogs or swine faculties denied to themselves,—as, for example, that the former are cognizant of spiritual phenomena, and that the latter can see the wind. The researches of modern zoologists* have certainly brought to light an amount of intelligence among the lower orders of animals that we little suspected in former times; and the attempt to elicit and develop, by careful training, such intelligence, has become to many an interesting pastime. We notice, also, that an exceptional regard to the habits of particular species has not only found an embodiment in the

* Recently the researches of Dr. M'Cook in regard to the ant deserve especial attention.

popular superstitions of various nations, but has even crept into their sacred writings. This result is perhaps partly due to the fabulists and moralists who have utilised familiar objects in order to convey moral and religious truths more pleasantly to the people. But the more rigidly scientific and exact methods of modern enquiry have tended to reveal more fully, to reflective minds, the *harmony* of Nature, the perfection of the various parts of her machinery, and their adaptation to one another; and also to show how the great Author of Nature has adjusted the springs with unerring hand, making precise compensation in the balance, and distributing with infinite wisdom both intelligence and force.

Certainly there is much more scope for enquiry among the lower creatures than many persons are aware of, as a careful study of the ant, the bee, or the spider will reveal, and has, in fact, revealed in recent times.

The following incident may serve as an illustration both of the mechanical dexterity and audacity, and also of the occasionally *social instinct*, of the last-mentioned creature; and possibly of the same law under which birds become tame upon the approach of severe weather:—In the autumn of 1878, upon a table on which the writer was dining, four candles were placed in an elongated diamond-form. They had not been lighted long when a tiny spider, scarcely larger than a pin-head, was observed to have hung his lines after this fashion (see figure):—



Spider's Web attached to Summits of Candles.

The summits of the candles were connected by a single line, rigidly strung, and uniting the very cups formed by the heat of the flame rising from their centres. It seems absurd to suppose that such a delicate thread could have been floated into this symmetrical form by atmospheric agency, in a room where the currents of air would necessarily be much disturbed; especially if we consider the fact of the flames being less than half an inch from each point of attachment to the candles. It would, again, be equally absurd to imagine that the tiny creature had ascended each candle sepa-

rately, drawing the line after it, as the table must have presented numerous obstacles to this method of construction. The probable method in such cases seems to be that the lines are projected with precision from one point of adherence to another; possibly they are weighted for the purpose. This would appear to be the only way of placing a delicate filament in so extraordinary a position; and that it is the actual method used, I had, soon after the above-mentioned incident took place, a strong proof.

A small spider appeared suddenly upon the sheet of paper on which I was writing. I advanced to the window, holding the sheet in my hand, to inspect the stranger. In the other hand I held another sheet of paper, the edge of which I placed within about a foot of that on which Sir Spinner was disporting himself. Having ascended to the edge, he at once darted over the intervening space with such rapidity as almost to elude vision. It seemed that he had projected a line, with great precision, to the opposite side of the gulf, the very moment he gained the "point of vantage," and then had sped across with lightning rapidity, drawing up the line as he advanced.

Speaking of *Araneæ*, I may mention in connexion with the severe winter, 1878-79, that, shortly before the frost began, I noticed several of the smaller species in a half-torpid state upon lines dropped from the old-fashioned high mantel-shelf in my room. They remained motionless for a considerable time in mid-air, apparently enjoying the warmth.

Here we have probably an instance of that tameness which finds another expression in the approach and entrance of small birds into human dwellings when intense cold is near at hand. Whether this change of habit arises from a vague anticipation of misfortune and a consequent craving for sympathy, or merely from the failure of the food-supply depending on the existence of creatures weaker than themselves, it seems evident enough that there is a consciousness of the fact that man is to a certain extent the controller of Nature's resources and the almoner of her bounties.

The Meteorological Society, in publishing its "Phenological" Observations, has fully recognised the importance of noting first and last appearances; and in the Entomological Report Mr. Griffith puts in a claim for the spiders. He alludes to their supposed remarkable perception of the *probable future condition* of the atmosphere; and notes the opinion expressed by M. De Tijonval, that their first appearance should be proclaimed with the "sound of trumpet,"

A connexion between the movements of the animal world and the revolution of the seasons has been observed since the earliest dawn of Science, and to explain those movements may still furnish problems for the acutest of naturalists; but it would appear to be inferring too much to conclude, from their ordinary migrations, a possession of prophetic *insight* into the course of the weather. It seems more rational to believe, with regard to most of these appearances, that it is by virtue of their highly-developed senses and peculiar nervous organisation that some species become predictive *in their habits*. Whether the supposed presentiment which induces them to deviate from their normal line of action arises simply from a vague feeling of disquietude, or results from an actual perception and connotation of various phenomena which escape the human observer, is very difficult for us to decide.

To observe with exactness and to compare notes in a certain fashion are arts in which many insignificant creatures excel, and human beings are very apt to underrate both the power of observation and of "co-relating" in animals. The very conditions of their existence give them indeed an advantage as compared with the more artificial life of man, inasmuch as they are more *en rapport* with the physical forces of Nature, and more in harmony, therefore, with their onward movement.

It has been said that, in regard to weather prediction, the conditon of the barometer cannot, in any direct way, be regarded as prophetical, as it simply registers the *present* condition of the superincumbent air; yet by virtue of the association of phenomena, it must be allowed to be *practically* prophetical, inasmuch as it registers conditions which, in a general way, have a certain sequence.

And it appears that this simple law of the association of phenomena applies also, and with perhaps greater force, to the movements of the animal world: for it can scarcely be doubted that animals are in many cases highly sensitive recorders of atmospheric influences, and that they often register the action of those more subtle forces to which the movements of the barometer are less intimately related.

IV. THE TEMPERATURE OF THE SUN.

By W. Mattieu Williams.

IN the last number of the "Monthly Journal of Science" Prof. Langley compares the radiations from the sun with those from a surface of molten metal which presents to the thermopile a disk of equal angular diameter, and bases his estimate of an inconceivably high solar temperature upon this experiment.

If we had any reasons for concluding that the surface of the sun is a heated solid, or liquid as athermanous as molten iron, his method might justify his conclusions; but all we know of the sun leads to the conclusion that the photosphere is composed of flaming or incandescent gaseous matter, the outer or superficial strata of which are permeable by the radiations from the incandescent matter below or within. If so, it is evident that the effective radiations from such a body must be increased, not merely by the extent of its surface, but also by the thickness or depth of the diathermanous incandescent matter; and a comparison between a disk of this and another similar disk of an athermanous body that radiates only from its surface must be quite delusive when applied for comparing their *temperatures*. This may be illustrated by simply presenting a plate of heated iron to a distant thermometer or thermopile, and then carefully placing behind this another plate of equal or less diameter, and equally heated. If direct radiation from the second is prevented, the thermometer will not rise when it is placed behind the first. Now try a similar experiment with two gas flames, and the effect of the radiation of the second flame *through* the first will be seen at once, though the surface of flame presented and the thermometer remain the same, and the temperature of the first or front flame is not sensibly raised.

In Chapters 7 and 8 of "The Fuel of the Sun" I have described a series of experiments made for the purpose of determining the transparency and diathermancy of flame to its own special radiations. The experiments on transparency were conducted with the advantages of the best attainable apparatus, — the photometer and dark chamber of the Official Gas Examiner of the Sheffield Corporation,—and the results showed that with proper precautions, there described in detail, the light received upon the screen of the photometer from a given number of gas-jets, each burning

an equal quantity of gas per minute, was the same whether the jets were arranged with all their surfaces presented to the screen, or with the surface of only one presented, the others being ranged behind that one and at equal mean distance to the larger surface; or, in other words, that thickness or depth of flame is a factor of equal value to that of surface area. The flame itself was found to be transparent, but the products of its combustion not so. The diathermancy of flames was similarly tested, but with inferior apparatus. The results showed that every additional flame placed behind others increased the thermal radiations from a given restricted area facing the thermometer; but the increase was not so strictly proportionate to the quantity of gas consumed as in the case of the luminous radiations. The variations, however, were not greater than the limits of error due to the rude experimental appliances.

Further investigations are demanded for reliable quantitative determination of the amount of thermal radiations which will pass through a flame or flames of given thicknesses. My experiments *indicate* (though not sufficiently delicate to *prove*) that a flame offers no resistance at all to the passage of the thermal radiations from a flame similar to itself; and if I am right, the vast energy of the solar rays demand no preter-terrestrial *intensity* of temperature in the sun, but merely a great *quantity* of heat, due to a great depth of flame of no higher temperature than is produced here on earth by the re-combination on the photosphere of those elements which we are justified in regarding as dissociated in the interior or lower regions of the solar envelope, and re-combining in the photosphere.

As Prof. Langley is familiar with the phenomena of the Bessemer process, I will direct his attention to a magnificent illustration of the effect of body or thickness of flame which it affords. Every chemist knows how feeble is the luminosity of the blue flame which accompanies the combustion of carbonic oxide. When the spiegeleisen is poured into the Bessemer converter some of the carbon of the spiegel combines with the oxygen of the fused oxide of the blown iron, and a huge blue flame of unmistakable character emerges from the mouth of the converter. Its intrinsic luminosity is visibly small, comparable to that of the flame we produce in the lecture experiment of decomposing oxalic acid in a test-tube, and lighting the carbonic acid at the tube's mouth. The radiant energy of this body of pale flame (which has no hollow centre like common flames receiving their oxygen from the outside atmosphere) is nevertheless wonderfully

great, as may be seen by observing its illumination of distant objects. The Bessemer shop at Sir John Brown and Co.'s Works, Sheffield, had window-openings at the sides and roof; and standing on Grimesthorpe Hill, half a mile away, I have frequently, on misty nights, seen beams of light pouring through these openings, and stretching to the low clouds, on which the image of the opening was projected as on a screen. In all weathers the night illumination of these windows by the carbonic oxide flame was magnificent.

It appears to me that this subject is of great philosophical interest. If the sun has a temperature approaching that assigned to it by Prof. Langley and others, all hopes of studying solar physics by comparison with terrestrial phenomena are at an end. The revelations of the spectroscope must be but snares and delusions, since the activities of gaseous molecules or atoms incandescent at such temperatures should set their wave-lengths and refrangibilities at such variance with those in our laboratories that we must either fail to recognise them or remodel our accepted theories of radiation. If, on the other hand, they have temperatures similar to those produced by the combinations of terrestrial elements, we may venture to accept the conclusions of the spectroscopist concerning their identity, and reason upon possible effects of their dissociation and re-combination, our reasoning being then based on the only data we possess, *viz.*, terrestrial experience.

V. LONGEVITY, OR THE NATURAL DURATION OF LIFE.

THE subject of Dr. Richardson's Opening Address at the Croydon Congress of the Sanitary Institute of Great Britain, recalls to our mind an admirable paper "On the Longevity of Brain-Workers," read at a Meeting of the American Public Health Association, in 1874, by Dr. George Beard, of New York.* Dr. Beard wished to prove the error of the accepted teachings in regard to the effect of mental labour. He therefore obtained statistics on the general

* Quarterly Journal of Science, vol. v. (N.S.), p. 430.

subject of the relation of occupation to health and longevity from the registration reports of England and America, and he also studied the lives of many prominent brain-workers. So far from confirming the generally-received theory that the mind can only be used at the expense of the body, his researches led him to conclude—

1. That the brain-working classes—clergymen, lawyers, physicians, merchants, scientists, and men of letters—live very much longer than the muscle-working classes.
2. That those who follow occupations that call both muscle and brain into exercise are longer lived than those who live in occupations that are purely manual.
3. That the greatest and hardest brain-workers of history have lived longer on the average than brain-workers of ordinary ability and industry.
4. That clergyman are longer lived than any other great class of brain-workers.
5. That longevity increases very greatly with the advance of civilisation, and that this increase is too marked to be explained merely by improved sanitary knowledge.
6. That although nervous diseases increase with the increase of culture, and although the unequal and excessive excitements and anxieties attendant on mental occupations of a high civilisation are so far both prejudicial to health and longevity, yet these incidental evils are more than counterbalanced by the fact that fatal inflammatory diseases have diminished in frequency and violence in proportion as nervous diseases have increased; and also that brain-work is, *per se*, healthful and conducive to longevity.

The title of Dr. Richardson's Address was "Salutland; an Ideal of a Healthy People." About three months ago Dr. Richardson and Mr. Chadwick discussed with Professor Owen the question of longevity and the natural duration of life of different classes of animals.

"With his usual scientific accuracy and industrious research, Owen had estimated, from various data he had collected, the natural term of life of that curious animal, the hippopotamus. He had learned that its term of life is thirty years. He explained to us the mode by which he had arrived at that fact; how into the calculation it had been necessary to take into account the dentition of the animal; the stages of development; the natural wearing out of the

teeth; the period of gestation; the development of the skeleton into the perfection of a bony fabric, with particular reference to the combination of the epiphyses or loose ends of the bones to the shafts of the bones; and lastly, the pathological or diseased condition of the dead animal of the species that had arrived at its full longevity, in order to determine whether or not there was evidence of cause of death from disease of some particular organ, or whether there was no such evidence, but simply a history of general decay from old age pure and simple.

"We were told that in a hippopotamus which had recently died, and which was known to have just turned thirty years of age, the two sets of teeth had fulfilled their allotted duty; that the bones of the skeleton were duly consolidated; and that the organs of the body were equally degenerated; so that death had occurred not from failure of any particular organ, but from failure of the organic parts altogether. In a sentence, the animal had died a natural death, and the constant of the term of life of it and its family was set down at thirty years, a constant to which all the facts that could be collated in respect to this species of animal definitely pointed.

"From this line of facts in respect to one type of animal life we were led to others, and the rule laid down by the distinguished Flourens—by which the determination of natural old age is calculated on the basis of perfected maturity—was brought under review. The skeleton is perfected when the epiphyses or loose terminal parts of long bones are firmly united with the shaft of the bone. When the date of such perfection of development is known in the mammalian class of animals, the simple process of multiplying the age at that date by five gives the natural anatomical life of the animal. The elephant came before us as an example. A young elephant, whose history has been related in the "Philosophical Transactions," died at the age of thirty years. At that age the epiphyses of its bones were not completely united with the shafts. It was nearly, but not quite, matured. Multiply thirty by five, and one hundred and fifty years stand as the natural estimate of the life of the elephant; so that really an elephant might exist which had itself carried all the Governors-General of our Indian Empire. Moving from this animal of long life, we turned to the camel, to find full maturity at eight years, full life at forty. We turned to the horse, to find full maturity at five years, full life at twenty-five. We turned to the lion and the ox, to find full maturity at four years, full life at

twenty. We turned to the dog, to find full maturity at two years of age, full life at ten. We turned to the cat, to find full maturity at eighteen months, full life at seven and a half years. We turned to the rabbit, to find full maturity at one year, full life at five.

"From these contemplations our minds very naturally reverted to the animal, man, to the members of the human family. Man, we learned, follows the same rule as the rest of living beings. Judged by the same test, his full maturity and full age may be calculated with equal precision. His maturity—perhaps not quite the full maturity—is twenty years. His full age, therefore, is one hundred years. This is the anatomical estimate of human life, the surest and by far the best of all that can be supplied, since it defines a law irrespective of and over-riding all those accidental circumstances of social and physical storm and strife which may interfere, and indeed do interfere, with every estimate based on the career of life itself, as it is shown in the ephemera by and through whom it is phenomenally demonstrated."

"This lesson," Dr. Richardson continues, "struck Mr. Chadwick and myself with singular force. On a surer basis than we ever trod, it corroborated a view we had ourselves promulgated from entirely different stand-points: and it further corroborated a similar view which had been advanced by our eminent friend, Dr. William Farr. We were led, in a word, once again, to the inevitable conclusion that man, even in this stage of his probation on the planet, is naturally destined to walk upon it, endowed with sensibilities of life and intelligence, for a period of one hundred years, and that until he realises this destiny practically he is—in value of physical life—actually degraded far below his earth-mates whom he designates the brute creation, and over whom he presumes to exercise his, to them, almighty will.

"To certain parts of the scheme of natural life there is a boundary. The period of maturity of development has its boundary of twenty years,—when the body, as Flourens says, ceases to grow; but if it ceases, in the ordinary sense of the term, to grow, it does not cease to increase; its nutrition improves and perfects for twenty years more at least, and then only has reached its completed physical condition. It should never from that period gain in weight, and for a long time it should not lose. It goes on now through a third period, which Flourens admirably calls the period of invigoration, during which all its parts become firmer, all its functions more certain, all its organisation more perfect;

and this period covers thirty years. At seventy old age begins; the *first* old age, in which naturally the fruits of wisdom are most bountifully developed, and which lasts from fifteen years to twenty, to mellow down to a period of *ripe* old age, commencing at eighty-five years and lasting fifteen years more, *i.e.*, until the constant is attained.

"And yet there need not now be death; for though, as Lord Bacon has said, old men are like ruined towers, and though, as Flourens has quoted, youths live in a double sense, with forces in reserve and forces in action, *vires in posse et vires in actu*, the *radical* forces and *acting* forces of Barthez, while old men live only on the forces in action, '*vires in actu*,' possessing no reserve, it is wonderful how the forces in action will continue after the reserve is withdrawn. This kind of half-life has continued unquestionably many years beyond the fulness of age, both in man and lower animals, and to give it twenty years beyond the natural hundred is to be just without being in any extreme sense generous.

"What we call death is gravitation; what we call disease is some accidental shot inflicted, it may be, while still the self-resistance to gravitation is in operation; what we call natural death is the gradual overweighting, at different periods, of the natural powers, reserve and acting, by the persistent force that bears us down. We cease to grow at a certain stage of our life, because of the resistance of this downward force; we cease to increase in size from the same cause; we consolidate in structure from the same cause; we bend in old age from the same cause; and we die from the same cause. Every step has practically been a death from the same cause.

"If the civilised world would continue in the ascendant, it must learn to live. An average life of forty-one, and under favourable circumstances of forty-nine years, with a world of disease and death up to that period, and a scattered struggle of the fittest for an exceptional existence into ripe old age, cannot maintain the relative efficiency of any nation, except in a world universally and equally bad."

As an answer to the question how civilised man should live in order that the natural term may be found, Dr. Richardson created an ideal people, having an ordinary term of life of one hundred, and prospective term of one hundred and twenty years.

This ideal people, believing that all cities have an equal right and an equal importance, possessed no capital city, no special seat of government, no professed politicians, no

army, no lawyers, and no paid physicians, every inhabitant possessing a knowledge of the laws of life and health. Animals are, however, used by this model people. Their fleeces are used for clothing, their milk for food, and many of them are made to work. The elephant works with an intelligence and skill that is almost human, and with a power that is superhuman, so that he is one of the most useful and faithful, and best-beloved of all the lower animals in the land. He is the rival of the horse, which is also much cared for, and is bred in a state of great perfection for bearing the rider, to which duty he is mainly consigned.

The roads leading from one part of the country to the other are maintained in the most perfect efficiency, smooth in all parts, and dry as our best asphalte of to-day. Transit along these highways on horseback and by velocipede has supplanted most other modes of personal conveyance. The cost of coal has rendered steam locomotive power very limited, while aërial locomotion has replaced steam-propelled carriages in a marked degree. But that which has effected the greatest change in respect to locomotion has been the facility with which persons in all parts of the Commonwealth can converse by telephone at any distance from each other, the act of journeying at a pace above 40 miles an hour being considered an unnecessary expenditure of means and physical energy.

In the course of scientific development the philosophers of Salutland were led slowly to the demonstration that, in every case, crime and insanity are synonymous psychological conditions. Descending from the highest insanities to the lower and the lowest, they traced out perfect analogy; they detected that on matters of crime many men and women might be mad, while on other matters they were sane, and even capable of performing good and useful works. Thus, analysing natural facts, they became in time bold enough to act on what they had learned. The man who can commit a crime is insane, and must be treated accordingly. To punish such a man in the ordinary meaning of that term is to try to cure one crime by committing another, which is absurd, and would be an indication of general insanity. So the insane man from crime is put with the other insane. He is moved with them to a separate colony, where, according to the nature of his offence and the character of his affection, whether it be deeply hereditary or not hereditary, and so on, he is subjected to a seclusion in which he can do no one any harm, and to such supervision and improvement

as may render him fitted to re-enter society. His banishment is softened by the permitted visits of friends, and when recovery is completed he is free. But in confirmed cases where the criminality is incurable, the law is inexorable: incurable mad men and mad women, treated with all imaginable care and consideration, are retained apart to the end of their lives. They must not corrupt others. Most of all, they must not be the fathers and mothers of a new progeny, corrupted by that most silent and potent of all corrupting influences, hereditary taint.

The education of this ideal people is never forced. Hard examinations, prizes, rewards for work,—all these stimulants would be held as mentally poisonous, mere excitants of local emulation, to the exclusion of the general. Learning is universally appreciated, and the office of teacher is amongst the very highest in the social scale.

It is, further, a part of the whole economy of the Saluts that they never dream either of killing themselves or injuring themselves by work on the one hand, or by retirement from work on the other. They hold that a human being is constructed to perform a certain amount of work. His heart is born to deliver a certain number of beats,—say, in one hundred years of natural life, three billions six hundred and fifty millions of beats. He is constituted to develop in the various organs of his body so many trillions of active cells, which make up his molecular organism, and which, duly supplied with force derived from without, are capable of performing so much work as they live and die. More force of heart, more development of cells, more life in short, no man or woman can ever possess than that with which they are primitively endowed, as far, at all events, as are yet known, and all the free will in the world cannot change this one fundamental fact. At the same time free will can do this much: it can use its own as it likes; it can wear out its cell life altogether equally and sedately, and so live the whole allotted time, keeping a good margin; or it can wear out its cell life altogether and rapidly, leaving no margin; or it can wear out the cell life of one particular organ—brain, heart, stomach, liver, kidney—by excessive use and exhaustion of the cells of such organ, and so can kill the whole organisation by the death of one organ, the rest of the organs being still in condition, perchance, for years of activity. He only should retire from active work from whom work retires, is another idea and practice so faithfully followed that every town yields many workers who, like Titian the Great, are doing their full quantity at the centenaries of

their births. For all necessary purposes—such is the easy and equal distribution of labour, and so comparatively light are the tasks of labour—from three to four hours in the twenty-four are sufficient for everything that needs to be done, by the busiest of the busy, to keep the social machine in perfect order.

Thus, in Salutland, ample time is left for the pursuit of every useful, healthy, and ennobling occupation. Its happy people cultivate every beautiful and refined art, every branch of natural science; their literature, chiefly of Nature and of Life, and History of Life, while it has lost none of the brilliancy and point of the present rapid method, is deeper and richer and newer. The age of criticism has passed away. To visit all the planet, make the grand tour of the earth; to know all history by biography, so that no man or woman who has helped humanity a hair's-breadth on its way may escape their appreciative and correct knowledge; to compare all artistic existence with the nature from which it sprang; to read men through the languages they have spoken; to study the physical directions of mental phenomena, and from the repetitions of history to forecast even history: these are the studies of their learned men, and the texts from which the learned impart their stores of erudition. To perfect these studies every means is offered by which, without prize-giving or other false stimulus, the choicest rivalry may be naturally imported. Music is most perfected. The stage maintains its reputation, and is utilised to the grandest purposes. Art in the form of sculpture is encouraged with the greatest care. Architecture is another profession which vies in splendour. Here, too, the true painter has found a home. Science is the unembodied Nestor of the teacher and the taught. To know is to exist; and Science is knowing, existing. For the museums of Science, the collections of the works of the Universal Father, the architect expends his best designing energies, the builder his finest work, the mechanist his choicest skill. Astronomy still heads the line of the pure sciences, chemistry follows, and meteorology, geology, natural history, anthropology, mechanics, and engineering, and other sciences find all their true places. Health science stands alone; it includes all the rest. *Salus salutis; scientia scientiæ.*

While thus, in systematised order, the gentle and refining arts and sciences are cultivated as exercises for the mind, the physical health is tended with equal care. Out-door life is the first thought, and out-door exercises of a skilful and useful character are to the fullest extent encouraged.

All the young are taught to swim, to row, to ride, to skate, to walk with ease and stateliness, to climb, to play at invigorating games, to dance, to speak in public, and to become efficient in the gymnasium. The daily ablution in the bath, the daily exercises of muscle and limb, are made as distinctive necessities as the taking of meals; and, withal, the dress in which the body of both sexes is clothed is made so loose and obedient to every movement that no deformity of body from dress is possible.

With regard to the health of the Saluts they have mastered the pestilential diseases. An epidemic from pollution of air, of water, of food, is with them impossible. The hereditary tendencies to disease are either lost altogether or are so nearly eradicated as to be practically removed. The diseases incident to poverty are stamped out by the removal of their cause. The diseases incident to intemperance and luxury are stamped out by the removal of their causes. The diseases incident to occupation are stamped out by the careful and easy expunging of everything that is injurious in occupations. The diseases incident to worry are stamped out by the abolition of maddening, exhausting, and useless strifes and ambitions. In a word, this people contends only with the natural elements,—the heat of the sun, the flash of the lightning, the changes of atmosphere,—from the fatal effect of which they rarely suffer; and with the one destroying inevitable power, the gravitation of the earth, which brings old age and death.

Thus, with the fewest accidental exceptions, the men and women attain the sacred age. Their death-rate is normal and constant, at eight in the thousand per year, and death itself—painless, final sleep—is hardly more than departure to rest when the day of work is done.

Referring to the simple means by which these results were achieved, Dr. Richardson says these settlers had become indoctrinated in their own land with the elementary truths relating to public health. They had learned the lesson of physiology; they had acquired a certain knowledge of what were and what were not healthy places. They had learned the history of the diseases produced by uncleanliness, had become practised in the useful and innocuous distribution of sewage, and had seen the dangers that arise from pitching dwellings in damp localities, and in building dwellings with materials that absorb and hold water. In accord in spirit, with the best information on these points, they carried out the spirit to the letter in their practice, and so began on a new and sound foundation. Ignoring all thought of false

economy, destroying by fire all carriers and sources of contagion, and providing for the instant isolation of every case of contagious or infectious disease, they stamped out the communicable diseases wholesale, with a success and readiness which were surprises even to the most sanguine preventionists, and which gained for them ten years of life.

The science of medicine, which in its true and honest position is always in the front rank of advancement, was somewhat changed. The doctors continued to keep a correct history of diseases, of the course of diseases, and of the causes of diseases, but they added an equal knowledge of prevention, particular and general, and valued that knowledge most. Dismissing all special modes of cure by particular systems or assumed specifics, they determined to know once and for ever what diseases would not get well without the aid of medicines of any kind, the general conditions for recovery being rendered as perfect as was possible. This discovery of the triumph of preventive art did not, however, satisfy altogether. It left on record the fact that Nature never goes out of her path to cure, and that what has been called the *vis medicatrix naturæ* was as much a myth as any other of the past myths of physic. It left on record, also, that under the happiest apparent external conditions some diseases will run their fatal course as decidedly without medicines as with them.

The diseases which so progressed were, in turn, discovered to be diseases of what we call constitutional type, depending upon heredity. They were four in number: scrofula, with its attendant, pulmonary consumption; cancer; specific disease; and insanity. The majority of the physicians, seeing the results I have named, began at once to teach that, as these diseases were obviously diseases of descent, and were maintained by the intermarriages of persons subject to them, there was only one sure and certain mode of removing them, and that was a common-sense rule that such intermarriages should not be tolerated.

The physiologists, dealing with the two questions of digestion and food for digestion, were led to the conclusion that a considerable shortening of life was induced by the excess of work which was put on the digestive organs. They bore in mind that many persons die from the wearing out of one particular organ, the rest of the organs being still healthy. Of all organs they agreed the stomach is most exposed to this danger. They found, on inquiry, that the stomach was distressed both by quantity and quality of food. Following a suggestion thrown out by Flourens, they

decided, on anatomical grounds, that man was neither herbivorous nor carnivorous, but a frugivorous, or fruit-eating animal. Next they estimated the precise amount of food and of drink that was necessary to support the reserve and the active life in the varied stages of life. Again, they determined the reduction of food that is required when the reserve life is withdrawn, and when the active life being left alone, it is the more requisite that no additional surplus of tissue or fluid, fat or water, should encumber the body; that no excess of force should be supplied to the digestive organs to the deprivation of other organs equally important, and that no over-taxation should be cast on the digestive organs themselves. Step by step, they were led hereupon to the introduction of an entire change of food and feeding. Animals were given up as sources of sustenance; fruits became greatly in demand; the bread tree competed with wheat grain; the banana and the grape were called largely into use; the juices of fruits almost entirely superseded water as beverages; while chemistry, coming in always to the assistance of man, easily transmuted many vegetable substances into the most perfectly digestible of foods for every variety of age and constitution. Of purely animal substances, milk only, and the products of it, butter and cheese, retained full sway. Of the vegetable kingdom not frugivorous, cereals, pulses, tomatoes, potatoes, and other fresh vegetables, with the edible Fungi, retained their useful place; and in respect to quantity of food and drink, not more than half by weight began to be consumed compared with what had been consumed before.

The last of the later advancements in order of time, and the final in order of complete accomplishment of obedience to natural design, had relation to sleep and rest. When the sun became the fellow-workman of the people of Salutland, the redemption of their bodies from premature death was carried out with the fullest success. The people saved millions in money, but this was nothing to the other saving. That nervous system of theirs—that system which takes in the outer universe, which is stirred by its waves, and sleeps, if it be permitted, when the waves sleep—found at last its natural time for work and for rest. All Salutland laid down like one vast living world to enter oblivion, and to wake from it filled with another spell of life, ready and happy to greet another day.

If there were any hope of Dr. Richardson's city and people having any other than an ideal existence, we might

dismiss from our minds the arguments put forward by Dr. Beard in support of his theory; but as there is no likelihood of such a state of perfection being reached, at all events in the present generation, it will be well to consider the conditions which favour the brain-worker, with the view of extending some of them to the muscle-worker, or at any rate of improving his social and intellectual condition. The causes to which Dr. Beard attributes the greater longevity of the brain-working classes are—1. The inherent and essential healthfulness of brain-work. 2. Brain-workers have less worry, and more comfort and happiness, than muscle-workers. 3. Brain-workers live under better sanitary conditions than muscle-workers. 4. The nervous temperament, which usually predominates in brain-workers, is antagonistic to fatal, acute, inflammatory disease, and favourable to long life. 5. Brain-workers can adapt their labour to their moods, and hours and period of greatest capacity for labour, better than muscle-workers.

The study of vital statistics led Dr. Beard, moreover, to the conclusion that, other conditions being the same, the greater and richer the brain the greater the longevity; and he shows that the greatest men of the world have lived longer, on the average, than men of ordinary ability in the different occupations by fourteen years; six years longer than physicians and lawyers; nineteen or twenty years longer than mechanics and day labourers; from two to three years longer than farmers; and a fraction of a year longer than clergymen, who are the longest-lived class in our modern society. The causes of this exceptional longevity are—1. Great men usually come from healthy, long-lived ancestors. 2. A good constitution usually accompanies a good brain. 3. Great men who are permanently successful have correspondingly greater will than common men, and force of will is a potent element in determining longevity. 4. Great men work more easily than ordinary men.

VI. ATLANTIS NOT A MYTH.

By Edward H. Thompson.

OUR sturdy worker in the copper mine of Lake Superior, finding both himself and his vein of copper growing poorer day by day, determines to seek some more paying claim in the as yet unexplored portion of the copper country. He gathers his kit of tools together and starts, and, after many a hard hour's travel over the wild and rugged country, finds a region with abundant signs of copper, and where seemingly no human foot has trod since creation's dawn.

He strikes a rich vein, and goes steadily to work digging and blasting his way to the richer portions, when suddenly, right in the richest part, he finds his lead cut off by what looks to his experienced eye marvellously like a mining shaft. Amazedly he begins to clear out of the pit the fallen earth and the *débris* of ages, and the daylight thus let in reveals to his astonished gaze an immense mass of copper raised some distance from the original bottom of the pit on a platform of logs, while at his feet lie a number of strange stone and copper implements,—some thin and sharp like knives and hatchets, others huge and blunt like mauls and hammers,—all being left in such a manner as though the workman had but just gone to dinner and might be expected back at any moment. Bewildered, he ascends to the surface again and looks about him. He sees mounds that from their positions are evidently formed from the refuse of the pit, but these mounds are covered with gigantic trees, evidently the growth of centuries; and, looking still closer, he sees that these trees are fed from the decayed ruins of trees still older—trees that have sprung up, flourished, grown old, and died since this pit was dug or these mounds were raised. The more he thinks of the vast ages that have elapsed since this pit was dug, that mass of copper quarried and raised, the more confused he becomes; his mind cannot grasp this immensity of time.

"Who were these miners? When did they live, and where did they come from?" are the questions he asks himself, but gets no answer. However, one fact is patent to him—that, whoever they were, they will not now trouble his claim; and, consoled by this reflection, he goes to work again.

The traveller in wandering through the dense and almost

impenetrable forests of Central and South America suddenly finds himself upon a broad and well-paved road, but a road over which in places there have grown trees centuries old. Curiously following this road he sees before him, as though brought thither by some Aladdin's lamp, a vast city, a city built of stone; buildings that look at a distance like our large New England factories; splendid palaces and aqueducts, all constructed with such massiveness and grandeur as to compel a cry of astonishment from the surprised traveller; an immense but deserted city, whose magnificent palaces and beautiful sculpturing are inhabited and viewed only by the iguana and centipede. The roads and paths to the aqueducts, once so much travelled as to have worn hollows in the hard stone, are now trodden only by the ignorant mestizo or simple Indian. Of this deserted home of a lost race the traveller asks the same question as the miner, and the only answer he gets from the semi-civilised Indian is a laconic "*Quien sabe?*" And who does know?

The curious and scientific world, however, are not so easily answered, and various are the theories and conjectures as to these diggers of mines and builders of mounds and strange cities. One of the most plausible of these—one believed by many scientists to be the true theory—is this: Ages ago the Americans presented a very different appearance from what they now do. Then an immense peninsula extended itself from Mexico, Central America, and New Granada, so far into the Atlantic that Madeira, the Azores, and the West India Islands are now fragments of it. This peninsula was a fair and fertile country inhabited by rich and civilised nations, a people versed in the arts of war and civilisation—a country covered with large cities and magnificent palaces; their rulers, according to tradition, reigning not only on the Atlantic Continent, but over islands far and near, even into Europe and Asia. Suddenly, without warning, this whole fair land was engulfed by the sea, in a mighty convulsion of nature.

Now, this catastrophe is not impossible or even improbable. Instances are not wanting of large tracts of land, several hundred miles in extent, disappearing in a like manner. The island of Ferdinandea sudddenly appeared, and after a while as suddenly disappeared. In 1819, during an earthquake in India, an immense tract of land near the River Indus sank from view, and a lake now occupies its place.

The whole bed of the Atlantic, where Atlantis is said to have been situated, consists of extinct volcanoes. The

terrible Lisbon earthquake of 1755, and the later American shock, created a commotion throughout the whole Atlantic area.

That Atlantis possessed great facilities for making a sudden exit cannot be doubted. Its very situation gives good colour to the narratives of ancient Grecian historians and Toltecian traditions, that "it disappeared by earthquakes and inundations."

Not only is it within the bounds of possibility that it might have occurred, but if traditions so clear and distinct as to be almost authentic history are to be believed, then it did occur. Listen to what one of the most cautious of ancient writers, Plato, says:—"Among the great deeds of Athens, of which recollection is preserved in our books, there is one that should be placed above all others. Our book tells us that the Athenians destroyed an army that came across the Atlantic Seas, and insolently invaded Europe and Asia, for this sea was then navigable; and beyond the straits where you place the Pillars of Hercules was an immense island, larger than Asia and Libya combined. From this island one could pass easily to the other islands, and from these to the continent beyond. The sea on this side of the straits resembled a harbour with a narrow entrance; but there is a veritable sea, and the land which surrounds it is a veritable continent. On this island of Atlantis there reigned three kings with great and marvellous power. They had under their domain the whole of Atlantis, several of the other islands, and part of the continent. At one time their power extended into Europe as far as Tyrrhenia, and uniting their whole force they sought to destroy our country at a blow, but their defeat stopped the invasion and gave entire freedom to the countries this side of the Pillars of Hercules. Afterward, in one day and one fatal night, there came mighty earthquakes and inundations, that engulfed that warlike people. Atlantis disappeared, and then that sea became inaccessible, on account of the vast quantities of mud that the engulfed island left in its place." It is possible that the *débris* said to have been left by this catastrophe might be identical with, or the nuclei of, the *sargazo* fields that, many centuries later, Columbus found almost impenetrable. Again, Plato, in an extract from Proclus, speaks of an island in the Atlantic whose inhabitants preserved knowledge from their ancestors of a large island in the Atlantic, which had dominion over all other islands of this sea.

Plutarch, in his Life of the philosopher Solon, Herodotus, and other ancient writers, speak of this island as a known

fact; and it is impossible to believe otherwise than that Seneca thought of Atlantis when he writes in his tragedy of "Medea"—"Late centuries will appear, when the ocean's veil will lift to open a vast country. New worlds will Thetsys unveil. Ultima Thule" (Iceland) "will not remain the earth's boundary." He evidently believed in the unknown island and continent, and knew it would not remain for ever unknown.

Diodorus Siculus says that "opposite to Africa lies an island which, on account of its magnitude, is worthy to be mentioned. It is several days distant from Africa. It has a fertile soil, many mountains, and not a few plains, unexcelled in their beauty. It is watered by many navigable rivers, and there are to be found estates in abundance adorned with fine buildings." Again he says, "Indeed it appears, on account of the abundance of its charms, as though it were the abode of gods and not of men."

The situation, the description of the country, in fact every particular, agrees precisely with our idea of Atlantis; and what other land now in existence agrees in any way with this description—what islands of magnitude that contain navigable rivers, large fertile plains, and mountains?

Turning from our well-known ancient writers, we find, in all the traditions and books of the ancient Central Americans and Mexicans, a continual recurrence to the fact of an awful catastrophe, similar to that mentioned by Plato and others.

Now, what are we to believe? This, that either the traditions and narratives of these ancient writers and historians of both lands are but a tissue of fabrications, evolved from their own brains, with perhaps a small thread of fact, or else that they are truths, and truths proving that the Americas, instead of being the youngest habitation of man, are among the oldest, if not, as De Bourbourg affirms, the oldest.

Brasseur de Bourbourg, who Baldwin says has studied the monuments, writings, and traditions left by this civilisation more carefully and thoroughly than any man living, is an advocate of this theory, and to him we are indebted for most of our translations of the traditions and histories of the ancient Americans.

To the imaginative and lovers of the marvellous this theory is peculiarly fascinating, and the fact that there is plausible evidence of its truth adds to the effect. With their mind's eye they can see the dreadful events, as recorded by Plato, as in a panorama. They see the fair and fertile

country, filled with people, prosperous and happy; the sound of busy life from man and beast fills the air. Comfort and prosperity abound. The sun shines clear overhead, and the huge mountains look down upon the cities and villages at their feet, like a mother upon her babes: all is a picture of peacefulness. Suddenly, in a second, all is changed. The protecting angels become destroying fiends, vomiting fire and liquid hell upon the devoted cities at their feet, burning, scorching, strangling their wretched inhabitants. The earth rocks horribly; palaces, temples, all crashing down, crushing their human victims, flocked together like so many ants. Vast rents open at their very feet, licking with huge flaming tongues the terrified people into their yawning mouths. And then the inundations. Mighty waves sweep over the land. The fierce enemies, Fire and Water, join hands to effect the destruction of a mighty nation.

How they hiss and surge, rattle and seethe! How the steam rises, mingled with the black smoke, looking like a mourning-veil, that it is, and, when that veil is lifted, all is still, the quiet of annihilation! Of all that populous land naught remains save fuming, seething mud. It is not to be supposed that all perished in that calamity. Long before this they had spread over the portion of the Americas contiguous to the peninsula, building cities, palaces, roads, and aqueducts, like those of their native homes; and adventurous pioneers continually spreading north, east, and westward, their constant increase of numbers from their former homes enabling them to overcome the resistance offered to their progress by both natives and nature, till at last they reached and discovered the copper country of Lake Superior. That they appreciated this discovery is evinced by the innumerable evidences of their works and of their skill in discovering the richest and most promising veins. Wherever our miners of the present day go, they find their ancient fellow-craftsmen have been before them, worked the richest veins, and gathered the best copper; and it is supposed that they continued thus till the terrible blotting out of their native country cut short all this, and left this advancing civilisation to wither and die like a vine severed from the parent stem.

Having no further accession to their numbers, and being continually decimated by savages and disease, they slowly retreated before the ever-advancing hordes. Gradually, and contesting every step, as is shown by their numerous defensive works along their path, they were forced back to their cities on this continent that had been spared them

from the universal destruction of their country, where the dense and almost impassable forests afforded them their last refuge from their enemies, and where—reduced by war, pestilence, and other causes, to a feeble band—their total extinction was only a matter of time. Such is probably the history of this lost civilisation, and such would have been the history of our civilisation had we in our infant growth been cut off from receiving the nourishment of the mother countries.

Within the last twenty-five years all sciences relating to the past and present of man have been enormously developed. Old, worn-out, useless theories have been discarded, new facts have taken their places, discoveries have followed discoveries, each discovery helping to form, link by link, the chain of human history.

We are beginning to perceive that we are but yet young in the knowledge of human history,—that we have as yet picked up but a bright pebble of thought or glittering shell of theory, while before us lies the whole vast sea of human history unexplored. That we are beginning to acknowledge this is a good sign, for, when a man or mankind acknowledge their ignorance, they have at least a sure foundation to build upon.

Again, the spirit of bigotry—the spirit that told men to scorn and deride Galileo and Columbus—is fast passing away, and in its stead comes the spirit of rationality, a spirit that tells men to look upon a new idea or theory, even if it does run outside of the accustomed rut, with a reasoning if not favourable eye. And we have faith, as science grows to grander proportions and dispels some of the mist that now envelopes it, that some day not far distant will bring forward an historic Edison that shall bring together the faint voice of the prehistoric past and the bright clear voice of the present; that some future Champollion will discover, among the ruined cities of the Americas, an American Rosetta-stone that will complete the chain of human history. "The noblest study of mankind is man."—*The Popular Science Monthly.*

NOTICES OF BOOKS.

Spon's Encyclopædia of the Industrial Arts, Manufactures, and Commercial Products. Edited by G. G. ANDRE, F.G.S. Division I. London: E. and F. N. Spon.

WE have here the first section of what promises to be a voluminous, but at the same time a useful work. The arrangement adopted is to some extent like that of Muspratt's "Dictionary of Chemistry,"—that is, we have a series of what might almost be called distinct treatises arranged in alphabetical order. Thus the first half of the present volume is devoted to acids, from the acetic to the tartaric inclusive, the sulphuric being, however, placed before the hydrochloric, nitric, oxalic, &c. Such groupings will render a good index absolutely necessary for purposes of reference. In the meantime it is difficult to say whether certain substances are duly dealt with or not, since, if not found in what would seem their natural place, they may turn up afterwards under some general heading. This is the possible reason for the omission of the arsenic, phosphoric, &c., acids, under the section "Acids."

Under the head "Carbolic Acid" we find mention of a curious fact, biological rather than technological, but well worth putting on record. Even very brief contact of the strong acid with any considerable surface of the lower part of the body is usually fatal, whilst the arms and upper parts may be thus wetted with comparative impunity. "In one instance a man employed at a carbolic acid works, who often had his entire arms covered with the acid, died from the effects of some of the same acid spilt upon his leg." The enquiry is at once here suggested whether this fact is unique, or whether the same rule applies to any other poisonous agencies.

Picric acid is described under its elder synonym, carbazotic acid, the modern scientific name—trinitrophenol—not being given. A full list of the synonyms of every substance is, we think, greatly to be desired in a work like the present.

In treating of arsenic the authors inform us that its price is ruled to a great extent by "rings." In the first six months of 1878 a combination of merchants drove up the price from £7 to £12 per ton in three weeks, all surplus stocks being got rid of by consignment to the United States. "The combination, however, broke down, and the price fell, almost as rapidly as it had risen, to £8 per ton. Such combinations are readily carried out,

because the make is small—only about 8000 tons per annum—and is in very few hands." The supply being so limited it may perhaps be deemed singular that, in addition to its more legitimate uses, arsenic should crop up as it does in "violet powder," and even in French chalk, as has recently happened with tragic result. Such being the case we trust that the authors are mistaken when they say "there is reason to believe that it (the manufacture of arsenious acid) has yet to see its best days both in this country and on the Continent." On the contrary, it seems to us that, in deference to public opinion, very stringent regulations will be adopted at home and abroad concerning the industrial use of arsenical compounds.

In the notice of asphalte, as applied to road-making purposes, we find another interesting case, showing how industrial operations are often frustrated by the operations of speculators. "As often happens to new industrial schemes carried on on so gigantic a scale, it fell into the hands of speculators whose main object was not the successful working of the mine," but gambling in shares. "A ring was formed, which in a few months raised the price of the shares from 500 to 13,000 francs. This did not last, and in a short time the 13,000 franc shares were being offered at 25 francs each. Asphalte, however, was destined to overcome these difficulties, and, though it remained some time in the hands of speculators, it eventually took its proper place as an important and profitable industry."

Under the section on hydrochloric acid we find a somewhat elaborate notice of the noxious vapours question, including the chief provisions of the Supplementary Alkali Act of 1874 (37 and 38 Vict., cap. 43) and the somewhat formidable "recommendations" of the Commission which has recently completed its labours. The definition of the term "noxious gas," in the above-mentioned statute, borders upon the facetious. It is made to include sulphurous acid *except* that arising from the combustion of coals." This is the old—we cannot say good—rule: punish the small offender, and let the great sinner go free.

The recommendations sin by default in overlooking the relative fitness of places. One code is to be laid down for all parts of the kingdom. Any man who should erect an alkali works, say in the Isle of Wight or on the banks of Derwentwater, would encounter no more stringent regulations than if he had gone to work in South Lancashire, in the Black Country, or in the outskirts of Glasgow. We would "recommend," on the contrary, the absolute prohibition, in certain districts, of all works capable of generating nuisances, whether solid, liquid, or gaseous, and in other districts the concession of very great latitude.

It is of course somewhat premature to pass judgment upon a work of which so small a portion only has appeared. It seems to us, however, that whilst the arrangement leaves something to be desired, the matter may upon the whole be pronounced

valuable. Most readers will be able to find here useful information for which they might have elsewhere to make a long and tedious search.

Elementary Lessons on Sound. By Dr. W. H. Stone. London: Macmillan and Co.

The purpose of this little work, as the author informs us, is to "furnish information intermediate between Acoustics and Music proper, supplementary to both"—a task which appears to be fairly fulfilled. In addition, and we suppose as a matter of course in the present day, it gives "a concise outline of subjects required for examination.

Papers, Proceedings, and Report of the Royal Society of Tasmania for 1877. Tasmania: Mercury Steam-Press Office, Hobart Town.

The Royal Society of Tasmania is active, and is doing the right kind of work,—that is, work which can be better done in Tasmania than in any other part of the world. One point, however, we cannot help noticing with regret. Of the eleven papers published, seven—and certainly not the least valuable—are due to two of the Fellows of the Society, the Revs. J. E. Tenison-Woods and W. W. Spicer. The death or removal of either of these gentlemen would leave the Society, judging from present appearances, in a very unsatisfactory condition. We have great pleasure in putting on record the active and useful part played by the Governor and the Bishop.

One of Mr. Spicer's papers, "Plants as Insect-Destroyers," gives a very complete summary of phenomena not generally known. The fungoid genus *Cordiceps*, the species of which are parasitical on various beetles, wasps, and moths, is particularly described. Among unscientific observers the opinion still prevails that the insect, which of course ultimately perishes, is being gradually metamorphosed into a plant. There is, however, a rumour that a phanerogamous plant springs, in an apparently similar manner, from the decaying body of an insect. According to M. le Compte d'Ursel, during his travels in various parts of South America he met with an insect which he describes and figures as a thick, distinctly articulated grub, hard to the touch. When about to die it buries itself some centimetres deep in the earth, and expands till it assumes the appearance of a potato,

though still retaining its original shape. A stem is then produced, which shoots up and bears a crop of blue flowers. The author admits that the origin of the plant may be a seed contained in the body of the insect, but he evidently leans to the theory of direct metamorphosis. We wish this insect would have presented itself to Mr. Wallace or Mr. Bates during their abode in South America, so that this strange phenomenon might have been thoroughly examined. The discoverer does not seem to be either a botanist or an entomologist.

A paper on "New Britain and New Ireland," by the Rev. G. Brown, contains some interesting facts in animal geography. Thus the cuscus is found in New Guinea and New Ireland, but not in the intervening island of New Britain. The wallaby has hitherto been found in New Ireland alone. The only marsupial obtained in New Britain was a small flying squirrel. Strange reports had reached Mr. Brown of a race of men with tails said to live in the interior of New Britain. In consequence he arranged an expedition to the locality. Unfortunately one of the party, a sailor, got access to a bottle of gin, and was the cause of so serious an accident that the party had to return to the ship with the wounded man, and circumstances did not allow of a second attempt. This disappointment is the more to be regretted as the discovery of an ape in the islands south-eastward of New Guinea would have been hardly less interesting than the occurrence of tailed men.

In the discussion following upon the reading of a paper by the Rev. W. W. Spicer, on the "Foreign Plants which have been naturalised in Tasmania," particular mention was made of the blackberry and sweet briar, both of which thrive in Tasmania with a luxuriance quite unparalleled in England. The question was raised whether birds ever feed upon the blackberry or raspberry. With Mr. Spicer we think that they do not in Europe, but we are by no means certain.

The same author, in an interesting paper on "Silk and Silk-Producers," gives a satirical account of the medicinal uses to which insects were formerly put. Thus the yellow matter which exudes from the joints of the bilbeetle [? oil-beetle, genera *Proscarabæus* and *Meloe*] was held to be as efficacious in dropsy or rheumatism as in hydrophobia, and no doubt was so." That many of the medicinal virtues ascribed to insects were merely imaginary may well be admitted, but we must guard against supposing that if taken internally they would prove inert. The yellow matter above mentioned would very probably be found rich in cantharidin.

Mr. Morton Allport contributes a paper on the "Acclimatisation of Salmon in Tasmania." He appears to take a hopeful view of the results of the experiment. It may be mentioned that amongst the fishes found off the coasts some are absolutely identical with well-known inhabitants of the British seas, such

as the conger, the sprat, the horse-mackerel and the John Dorey.

We trust that the Royal Society of Tasmania will persevere in the course that it has evidently taken, working out the biology, geology, mineralogy, and climatology of the island.

Colour-Blindness; its Dangers and its Detection. By B. Joy Jeffries, M.D. Boston: Houghton, Osgood, and Co. London: Trübner and Co.

Dr. Jeffries had, it appears, originally intended to produce an English version of the work of Prof. Holmgren, "Colour-Blindness and its Relations to Railroads and the Marine." Being, however, anticipated by an abridged translation which appeared in the Reports of the Smithsonian Institute, he was led to draw up an independent treatise, covering, however, essentially the same ground. It must therefore be distinctly understood that the present volume is not, and does not profess to be, an exhaustive monograph of colour-blindness. The author's aim is essentially practical. He seeks to point out the dangers to life and property which may arise from the employment on railways or on shipboard of men defective in the colour-sense, and to explain in detail the best means for their detection. These dangers are undoubtedly real and serious. If one out of every twenty-five of the male population of civilised Europe and America is more or less unable to distinguish colours,—a truth which appears established,—there is a certain element of probability that the engine-driver or the look-out man, upon whose judgment our personal safety depends, may mistake the colour of a signal and rush headlong to his own and our destruction.

The more speculative, and to many men of Science the more interesting, phase of the subject, is but slightly touched upon. Little new light is thrown upon the ultimate causes of colour-blindness; upon the laws of its production by accident, disease, or immoderate narcotism; upon the *rationale* of its predominating frequency in the male sex, its relative occurrence in different races and nations, and its possible extension among the lower animals. The comparative delicacy of the colour-sense among the two sexes in birds, &c., becomes a very important point. If, as among mankind, the females are the most sensitive to colour, whilst the males are admittedly the most highly coloured, we have a strong confirmation of the hypothesis of sexual selection.

Nor does Dr. Jeffries discuss the alleged recent development of the colour-sense, nor the influence which its varying degrees of perfection may have upon decorative art or upon personal

ornamentation in different ages and in different nations. It would be, however, highly unfair to blame him for omitting subjects which he has intentionally excluded from his plan. What he has undertaken he has executed thoroughly and satisfactorily, and his work is hence an invaluable manual for the higher officials of railways, for the authorities of the navy, and for the proprietors of trading- and passenger-vessels. All such persons will here find what, in this respect, is their duty to the public, and how it may best be performed. To the medical profession it will prove an indispensable guide in the examination of supposed cases of colour-blindness.

The Music of the Bible; with an account of the Development of Modern Musical Instruments from Ancient Types. By JOHN STAINER, M.A., Mus. Doc., Magd. Coll., Oxon. London: Novello, Ewer, and Co., and Cassell, Petter, and Galpin.

THE author of this little book has carefully weighed the abundant though discordant evidences as to the identity of biblical musical instruments. The many sieges which Jerusalem has undergone have destroyed every monumental trace; a few coins are the only Hebrew source of information. Fortunately nations with whom the Jews were in constant intercourse, the Egyptians and Assyrians, supply abundance of material for the determination of the musical instruments in use by them, which may fairly be considered to have greatly influenced the musical resources of the Hebrews.

With respect to the origin of stringed instruments, Dr. Stainer is of opinion that the common hunting-bow is the parent of the whole family; and the series on page 72 show how easily the violin, guitar, dulcimer, and even the pianoforte itself, may have been evolved by a progressive series of alterations. Indeed the comparative anatomy, if it may be so called, of musical instruments seems to have been diligently studied by the author in his endeavour to show the probable nature of the resources of the Jewish orchestra. That the instruments varied at different periods of their history there can be little doubt. For instance, at page 97, Dr. Stainer remarks, "We have the same name (organ) for the single row of about fifty pipes, placed perhaps in a little room, and the mighty instrument of five thousand pipes, occupying as much space as an ordinary dwelling-house, and requiring the daily attention of a qualified workman to keep its marvellous complications properly adjusted; yet each is an organ. May it not have been the case that the '*ugab*,' which in Gen. iv., 21, is mentioned as the simply constructed *wind* instrument, in contrast to the simple *stringed* instrument, the

'*kinnor*,' was a greatly inferior instrument to that which in Ps. cl. is thought worthy of mention by the side of a term for the whole string power." It is only natural to suppose that instruments bearing the same name must have been greatly improved in the course of two thousand years or more.

The modern bell is shown (p. 142) to have been derived by a simple succession of developmental changes from the cymbal. The bell of ancient times could hardly be looked upon as a musical instrument, but was a mere ornamental appendage,—either little cymbals like the jingles on the modern tambourine, or like toy bells placed on dog-collars, &c. The bell proper appears not to have existed until the Middle Ages, and to have originated in Europe.

The last chapter is devoted to the consideration of Jewish vocal music: here the accents appended to the Hebrew text furnish some evidence, but explanations are conflicting, and modern traditions among the Jews of little value.

Dr. Stainer certainly deserves the thanks of musicians, as well as of biblical students, for his painstaking and elaborate researches on one of the most difficult subjects within the range of Archæology.

CORRESPONDENCE.

HEREDITY.

To the Editor of the Monthly Journal of Science.

SIR,—Your article on "The Criminal Law of the Future" is very interesting, and doubtless true; although if Oliver Cromwell had known of it he would probably have said that he had been a fool to stop short with only massacreing the inhabitants of Drogheda, in Ireland, and that Irish proclivities to murder and rebellion "proves only the more convincingly the necessity for their elimination" (p. 594). Furthermore, it would warrant the extermination of Zulus and other tribes.

But the question which struck me was, how is it that the principle of Heredity does not apply to genius? The learned Count de Maistre remarked of France—"A considerable portion of the literary glory of the French, particularly in the great century, belongs to the clergy. Science being generally contrary to the propagation of families and of names. Hence arises the ancient prejudice as to the incompatibility of science with nobility—a prejudice founded, like all prejudices, on some hidden cause. No learned man of the first class has been able to found a house. Already even the names of the sixteenth century that were celebrated in literature and science no longer exist."—I am, &c.,

WILLIS NEVINS.

Cheltenham.

SEA-SERPENTS.

To the Editor of the Monthly Journal of Science.

SIR,—Several alleged appearances of large sea-serpents have been lately recorded, but unfortunately they leave the question of the existence of such creatures precisely where it was. The being which struck and sunk the Norwegian barque *Columbia*, on September 4th, is described as "a fish or some other sea-monster," and may probably have been a large whale. The

creature seen by Captain J. F. Cox, of the *Privateer*, on August 5th, must have been a large ophidian if his description is trustworthy. But he will probably be at once proclaimed unworthy of credit. We are by no means sure that if such a serpent had been seen by the entire scientific staff of the *Challenger* their united testimony would have been accepted.—I am, &c.,

SERPENT-HUNTER.

THE ENDOWMENT OF RESEARCH.

To the Editor of the Monthly Journal of Science.

SIR,—In the able Address delivered by Dr. Pye-Smith, in the Anatomical and Physiological Department, Section D, of the British Association, as reported in your October number, there is one passage which seems to require comment. The learned speaker declared that he "should be sorry to see the endowment of research in biology," and it is to be presumed in other sciences also, "undertaken by Government funds." But those who advocate the endowment of research for the most part make no demands upon Government funds. They urge, first, that the present endowment of "cram" should cease, and that the positions and emoluments now handed over to successful examinees should be conferred upon discoverers; secondly, they demand that the fellowships of our old national universities should be made, as they were intended by their founders, the incentives and the rewards of original thought and research." "Local energy and unofficial zeal" have indeed done great things for England; but what have they done in this particular sphere? What would they even be permitted to do? Suppose a number of wealthy gentlemen agreed to found and endow a college where the highest honours should be attainable by research alone, would it receive official recognition and be permitted to grant any kind of degrees? We think not.—I am, &c.,

SCRUTATOR.

NOTES

Biology.

In a communication to the Academy of Sciences, M. L. Vaillant remarks that the fecundity of axolots being no longer contested, we are compelled to regard them not as a pathological modification,—an opinion still admitted by certain foreign *savants*,—but as a normal metamorphosis conformable to the cycle habitually known among the *Urodeles*. These animals, under certain conditions not yet determined, appear to reproduce themselves in two states—as larvæ and when completely developed. This is a fact not unexampled among the inferior Vertebrates and certain Articulates, as remarked by M. Blanchard in 1868 (*see* "Comptes Rendus de la Reunion de la Soc. Helvetique").

M. Galtier has undertaken a series of experimental studies on rabies, and has recorded the results in the "Comptes Rendus." He finds that rabies may be transferred from the dog to the rabbit, and from one rabbit to another, the predominant symptoms being paralysis and convulsions. It is impossible to say whether the virus of the rabbit has the same intensity of action as that of the dog. The period of "incubation" in the rabbit is shorter than in other animals, not exceeding eighteen days. Salicylic acid injected hypodermically every day for a fortnight, beginning with the fiftieth hour after inoculation, has not been found to interfere with the development of the disease. The saliva of a mad dog, taken from the living animal and kept in water, retains its virulence for twenty-four hours. (It is often asserted that the deaths of human subjects after being bitten by a rabid dog, ascribed to hydrophobia, are really due to a morbid imagination. We wonder if this plea will serve to explain the deaths of the rabbits experimented upon as above.)

According to MM. Callol de Poncy and Ch. Livon, in cases of chronic arsenical poisoning this element takes the place of the phosphorus normally present in the lecithin in the form of phospho-glyceric acid.

Prof. Balbiani gives an account, in "Leçons sur la Génération des Vertébrés," of the embryogenous cellule or vesicule which has been detected by many observers in the ova of various animal groups, vertebrate and invertebrate. He considers it as analogous to a seminal cellule which must exert upon the ovum an action similar to that of a spermatozoid. In many animals, it must be remembered, these elements have not the filamental form and are devoid of mobility. This is the case with most of

the Crustaceans, with the chilognathic Myriapods, the nematoid worms, &c. The germ in the female ovule is formed under the influence of a sort of fecundation exercised by this embryogenous cellule which represents the male element. It is always around this element that the plastic granulations are deposited. This cellule being a primordial male element, we understand that, with certain beings and in certain cases, its action is not limited to the formation of the germ. It may determine, in a manner more or less complete, either merely the first phases of the development of the ovum or even this development in its entirety, producing a perfect animal which constitutes parthenogenesis. Known facts prove that in various animal species—even Vertebrates—unfecundated eggs have undergone a more or less complete development, which, however, in no vertebrate species has been found to lead to the development of a perfect animal. Among Invertebrates—such as certain Lepidoptera and Hymenoptera (*Cynips*, species)—parthenogenesis is far from uncommon, and among the Aphides it has become the rule rather than the exception.

An account of the Cephalic Ganglia of Insects has been presented to the Academy of Sciences by M. N. Wagner. The sub-œsophagian ganglion governs principally the appendages of the mouth, and differs little in its histological structure from the other nuclei of the ganglionic chain. As for the cerebroid or super-œsophagian ganglia, they are the seat of nearly all the functions of the brain among the Vertebrates. Here are the organs of perception, of memory, intelligence, &c. Hence the histological structure is more complicated. Towards the centre of the ganglion are found three groups of small cellules, disposed in stages one above another. The greater or less development of these parts of the nervous system coincides with the intellectual development, and is more manifest in the working ants and bees than in the queens, and still more in the males where there exist mere rudiments of these organs.

M. Bacchi has examined the action of sodium phenate in the treatment of bacterihæmic disease. A drop of blood from a frog which had perished of this disease was injected under the skin of each of two healthy frogs. A day or two afterwards phenate of soda was injected under the skin of one, whilst the other remained without treatment. The former in every case recovered, whilst the latter died of bacterian blood-disease.

M. J. Renaut recommends for histological uses a solution of eosin and hæmatoxylin mixed with glycerin. He places in a test-glass 1 part by measure of neutral glycerin and the same volume of a saturated solution of eosin (aqueous or alcoholic), and then drops in hæmatoxylin prepared according to Boehmer's formula, until the green fluorescence becomes almost imperceptible.

tible. The violet liquid is then filtered. Its action is found very satisfactory.

According to M. Jolly the iron present in the blood globules exists exclusively in the state of phosphate.

MM. Marat and Ortille have observed that in uræmia the respiratory power of the blood is not strikingly changed until death is imminent. The respective proportions of oxygen and carbonic acid present in the arterial blood is also little altered. Ammonium carbonate is detected in the stomach, and ultimately in the blood also.

At a meeting of the Anthropological Society of Paris, M. Broca gave an account of certain observations made with a young Barbary ape. If shown an uncoloured likeness of any ape it at once gave signs of recognition. On seeing the coloured picture of a Macacus it attempted to search for fleas—the usual mark of friendship among apes. Before the figure of an orang-outang, whether plain or coloured, it expressed at once fear and curiosity; and before that of a sloth, irritation.

M. Dareste has in some instances found the amnios entirely wanting in embryo chickens.

M. Vulpian has been examining the action of certain "heart-poisons" upon the escargot (*Helix pomatia*). The alcoholic extract of the seeds of *Strophantus hispidus* and *muscarin* arrested the action of the heart in this snail in manner analogous to what is observed in frogs and mammiferous animals. Upon the heart of Crustaceans neither of these substances produced any perceptible effect.

The influence of a change of climate upon plants is pointed out by MM. Naudin, of Collioure (Pyrenées Orientales), and Radlkofer, of the Botanical Gardens, Munich, who have carried out a joint series of experiments on this subject. The mean annual temperature of the former station is 14·9°; that of the latter only 5·79°. They conclude that the more northern origin of a seed does not necessarily imply greater precocity in the resulting plant than if it had ripened in a warmer climate, inferences deduced from observations on cereals not being generally applicable. Seeds from a warmer locality may grow more rapidly and strongly in one and the same climate than those obtained from a colder source, as *Sonchus oleraceus*, *Solanum nigrum*, &c. In others, as *Calendula arvensis*, *Malva rotundifolia*, &c., the converse holds good.

Dr. Bureau has communicated to the Zoological Society of France a set of plates showing the transformations of the beak of certain birds of the family Mormonides. The beak has hitherto been considered an organ available for the demarcation of genera. The author, however, has shown that after the

breeding season the beak of *Fratercula arctica* falls off in nine portions. Hence this species has two forms of beak—one in winter, small, and covered at the base with a membrane; the other in summer, thick, large, robust, horny, and trowel-shaped; marvellously well adapted for digging the burrows in which this bird nests. A similar phenomenon is observed in all the birds of the North Pacific comprised in the genera *Fratercula*, *Lunda*, *Sagmatorrhina*, *Ceratorhynca*, and *Simorhyncus*. Hence many species which have been founded merely on the form of the beak will require revision.

MM. Couty and De Lacerda have made a series of experiments on the poison of the Brazilian serpent (*Bothrops jararacussu*). The animals bitten or inoculated with the poison, whether in its natural state or diluted with water, all perished in from two to ten minutes. The first action perceived was one of excitement, variable in its seat, as if the action of the poison was localised sometimes in one organ and sometimes in another. Death was always preceded by a complete paralysis of the brain and spinal chord, with relaxation of the limbs and acceleration of the heart.

M. J. Lichtenstein has carefully studied the metamorphoses of *Lytta vesicatoria* (the Spanish fly), which are exceedingly curious. The larva—like those of the nearly allied genera *Meloe*, *Sitaris*, and *Epicanta*—is piratical, infesting the nests of certain earth-bees, such as *Halictus* and *Andrena*, preying first on the eggs and young larvæ, and afterwards on the store of honey.

According to the very decided testimony of a Persian now resident in Paris, fair-haired persons are not unknown in his country.

M. Percy has communicated to the Société des Sciences Physiques et Naturelles de Bordeaux, a paper on the effects of the parasitism of the *Stylops* upon bees of the genus *Andrena*. Certain species of this genus were formerly supposed to be invariably beset with this parasite, but on closer examination the author discovered that they were merely abnormal forms of other species modified by the presence of the *Stylops*. In *Andrenæ* thus attacked each sex loses more or less its characteristic structure and colouration, and tends to acquire those of the opposite. In a Stylopised female *Andrena* the ovarian tubes are completely arrested in their development, inducing complete sterility. In the male a similar atrophy is confined to one side. These results are merely due to the pressure caused by the presence of the parasite.

A paper on the "Mutual Influence of Graft and Stock" is given in the "Zeitung für Land wirthe" (1878, No. 62, p. 353). E. A. Carrière grafted tomatoes upon common nightshade (*Solanum dulcamara*). Many of the plants reached the height of 3 metres, and yielded abundant fruit, differing little in appearance

from the ordinary kind, but much sweeter and containing fewer seeds. Jerusalem artichokes grafted upon the sunflower attained a gigantic height, whilst the roots of the stock in two places had developed tubers something like those of the dahlia.

At one of the last sittings of the Academy of Medicine Dr. Jollivet reported that sixteen persons, in the Department of Seine et Oise, have been seriously attacked with trichinosis. This is the first outbreak of the disease in France.

M. Fredericq has continued his researches on the blood of the octopus and the lobster. That of the former contains merely a single albuminoid species, the two great functions of the blood, respiration and nutrition, devolving upon one and the same chemical compound, hæmocyanin. In the blood of the lobster, in addition to the blue colouring-matter, hæmocyanin, there is found a rose coloured principle, soluble in alcohol. The blood of certain Gasteropods contains hæmocyanin, but it is not found in that of the Lamellibranchiæ.

Among the Primates the olfactory apparatus, the great limbic lobe, loses its importance. Among the apes there exists always a slight furrow, which extends as far as the fissure of Sylvius. M. Broca formerly considered this limbic furrow as characteristic of the apes, but he has subsequently detected it in all the brains belonging to the lower human races which he has been able to examine.

Abrassin oil is, according to the "Œst. Landwith. Wochenblatt," obtained in China from the seeds of *Elæococca cordata*, and is said to be an excellent protective against noxious insects. The tree, which belongs to the family of the Euphorbiaceæ, prospers in the South of France, where its culture is recommended, in the hope of the oil proving a specific for the *Phylloxera* and the *Oidium*.

The influence of quinine upon silkworms has been satisfactorily proved by C. Le Doux. Broods of caterpillars suffering from *flacquerie* were speedily restored by sprinkling their food with quinine sulphate. The same treatment proved successful in cases of "pebrine" with open wounds.

Cases of poisoning by caterpillars have been observed both in cows and ducks. The former experienced gastric symptoms, diarrhœa, loss of appetite, &c., but were all restored by means of mucilaginous drinks and a diet of boiled potatoes and bran. Ninety ducks were turned into a cabbage-field infested with the caterpillars of the common white (*Pieris brassicæ*). In one afternoon the field was almost clear, but two ducks died after an hour. The next morning twenty were found dead, and altogether fifty-three perished. The flesh of the dead, on examination, was found to resemble that of cattle which die of gangrene, indicating true poisoning.

Chemistry and Technology.

In the International Exhibition, now being held at Sydney, a collection of soils, manures, and agricultural products is shown by the Imperial College of Agriculture in Tokio, Japan. Accompanying the collection is a descriptive catalogue, compiled by Mr. Kinch, the Professor of Chemistry at the College, in which a short account is given of the various products exhibited, with about eighty chemical analyses. The catalogue opens with some analyses of soil. Then follow analyses of manures, including lime, wood ashes, nitre, waste vegetable substances, and residues from various manufactures, fish manure, bone, superphosphate, birds' dung, and hair. Next in order come analyses of foods. Then a summary of the dye-stuffs, and also of the various oils and resins.

In a paper on "Measures for Disinfecting," read at a Meeting of the German Public Health Association, at Stuttgart, reported in the "Sanitary Record," Prof. Hofmann said that disinfection can only be said to have been carried out when the following conditions have been fulfilled;—(*a.*) By considering the object or poisonous germ which is to be destroyed. (*b.*) By considering the place or object where the poisonous germs may be found or must exist. (*c.*) By a thorough knowledge of the mode of action and the qualities of the disinfectant that is being used.

At the Manchester Meeting of the Social Science Congress Mr. C. T. Kingzett read a paper on "The Eucalyptus and the Pine considered in relation to their Sanitary Properties." The action of the eucalyptus is stated to be of a positive type, and, like the pine tree, its properties are of a healthful nature, upon whatever soil or in whatever climate it may grow. The *Eucalyptus amygdalina* is the most abundant oil-giving tree, 100 lbs. of the leaves giving from 3 to 6 lbs. of the oil. This oil is practically identical in composition with the oil of turpentine derived from pine trees, and with most of the so-called essential oils or perfumes. By the investigations of Mr. Kingzett it has been ascertained that all these oils, when subjected to the action of atmospheric oxygen and moisture, produce peroxide of hydrogen and a number of camphoraceous substances having marked antiseptic powers. Taking New South Wales and South Australia alone, Mr. Kingzett calculates that the eucalyptus forests contain at any given moment sufficient oil in the leaves to form by contact with the atmosphere no less than 92,785,023 tons of pure peroxide of hydrogen, and 507,587,945 tons of camphoraceous principles. If it be remembered that in Nature all matters of animal and vegetable origin are oxidised by the atmosphere, which is thus kept free from the pernicious products of putrefaction, and that peroxide of hydrogen is a much more powerful oxidant than ordinary oxygen, and if it be also borne in mind

that the camphoraceous products above referred to are also powerful antiseptic agents, then the healthful influences of the eucalyptus can neither be wondered at nor be longer open to any doubt. What is true of the eucalyptus is also true of the pine, and on an immensely larger scale; and the oil of turpentine, which is a natural product of these trees, undergoes the same chemical changes in the atmosphere as oil of eucalyptus. By imitating this natural process of oxidation, Mr. Kingzett has, as is well known, succeeded in obtaining and rendering available in commerce the antiseptic and oxidising principles to which pine and eucalyptus forests owe their hygienic influences.

The adulteration of olive oil has become so prevalent that the Minister of Agriculture and Commerce has requested the Academy of Sciences to ascertain the most trustworthy method for the detection of such frauds. Among the procedures at present under examination by a special committeee is the use of the diagometer, an instrument devised by Prof. Luigi Palmieri, founded on the difference of the electric conductivity of oils. Seed oils are as a class better conductors than olive oil. At the same time every oil conducts the better the greater are its impurities. Linseed and cotton seed oil are among the best conductors, whilst the oils of pine seeds and of hazel nuts are almost as feebly conductive as the purest olive oil, known in commerce as virgin oil. Fortunately these two oils are too rare and costly to be used in the adulteration of olive oil. The use of the diagometer requires considerable manipulative skill.

At a recent meeting of the Berlin Dyer's Association the new colour, "Puteaux blue," manufactured by MM. Patry, of Puteaux, came under discussion. It was considered to be in all probability an indulin, but was pronounced not well adapted for wool-dyeing. For mixed colours upon silks, and as a ground for blues, it was said to be applicable. Dr. Reimann, in speaking of "pittacall blue," considered that at no very distant period the products of beech tar would be utilised for the production of artificial tannin.

The system of "weighting" of silks is, remarks M. Marius Moyret, ruinous to the silk-growing departments of France. Their high-class products are no longer in demand, as inferior and cheaper foreign silks serve equally well for loaded tissues. Hence these districts, already suffering from the *Phylloxera* and from the loss of the madder trade, are in the utmost distress. The author proposes that in the sale of silks, as in that of gold and silver, the proportions of the real article and of weighting matters should be exactly specified, and that a central office for the cheap and rapid assay of silks should be opened in Lyon. He states that the most excessive weighting has been carried out by a New York firm.

In connection with the general Congress of German Apothe-

caries, held at Hanover on September 4, was exhibited a collection of pharmaceutical antiquities, including a specimen of genuine oriental bezoar, a goblet of metallic antimony, formerly used for imparting a purgative effect to wine or beer, a venerable sample of "Album Græcum," a selection of chemical apparatus inscribed with alchymistic symbols, a gaily-adorned jar for containing "Mithridate," &c.

Instead of linseed-meal as a lute for distillatory apparatus, Thanisch proposes the use of strips of brown paper smeared over with bookbinders' paste to which one-eighth of glycerin has been added.

The chemical purification of waste waters has been studied by Jean de Mollins. The author, who has dealt with the waste waters from the woollen mills of Roubaix, recommends milk of lime and sulphate of alumina, together or separately. He considers that the action of the aluminous hydrate upon the organic impurities of water is quite analogous to its behaviour with dissolved colouring-matters which it throws down in the form of lakes. He also points out that clay, if diffused in water, becomes coagulated by the presence of certain salts, and carries the organic impurities down with it.

A new method of producing varnish is proposed by Dr. E. Schrader. He causes ozone to act upon linseed oil: it is at once perfectly bleached and brought to the proper consistence without the aid of fire.

From a report by M. de Luynes (Société d'Encouragement pour l'Industrie Nationale) on M. C. Lorilleux's manufacture of printing and lithographic inks, we find that two kinds of varnish are employed in the manufacture of printing inks; the one obtained by boiling linseed oils, and the other from a mixture of resin and resin oil, the latter being chiefly used for newspapers where rapid drying is of importance. M. Lorilleux allows his linseed oil to rest for two years at a constant temperature. It is then boiled by means of hot air, at a distance from the furnaces so as to remove every risk of fire. A mass of 2500 kilos. is boiled from twenty-four to fifty-six hours, and is stirred by a mechanical agitator. The varnish thus obtained is limpid and flows well. The lamp-black is produced either by means of specially constructed lamps or by the decomposition of naphthalin oils, which fall by drops into a heated retort. The gaseous products are carried off by tubes, at the end of which they are burnt under sheet-iron bells, whilst the black is carried off by a current of air into large chambers. It is afterwards submitted to calcination. All the inks, lithographic or typographic, are submitted to a practical trial before being sent out.

Some researches on damage to the soil and the crops by the waste waters and the gases from manufactures have been insti-

tuted by Dr. J. König. These researches relate, in the first place, to the waters from certain mines of zinc-blende in Westphalia, which pass into certain streams used for irrigation, and seriously injure the productiveness of the soil. The presence of zinc oxide in the earth is indicated by the presence of *Viola calaminaria*, which contains in its ash as much as 21 per cent zinc oxide. The author has likewise examined the waste waters from a dye works, a wire works, and from pyrites washing. The two latter he considers as directly poisonous to plants on account of their percentage of ferrous sulphate. The dye water may, by reason of the organic matters which it holds in solution or suspension, gradually overload the soil with humus, and render it boggy.

M. de la Bastie is said to have made great improvements both in the method of tempering glass and in the quality of the product. Among the articles shown to the French Société d'Encouragement are mortars with their pestles for chemical use. At the Liverpool Meeting of the Iron and Steel Institute Mr. C. Wood described the process of Mr. Frederick Siemens, of Dresden, for the employment of toughened glass for sleepers and chairs for railways and tramways. Mr. Siemens tempers and moulds the glass into various forms to suit the different requirements. The cooling of the glass is so regulated that the radiation from each point of the surface corresponds to the thickness of the glass, thus enabling the casting to be equally affected throughout when undergoing the tempering or hardening process. The regulation of the radiation or absorption of the heat in the thicker parts of the casting is done by having hollow iron moulds, and by circulating cold water or cool air at those points where the glass is thickest, so that the casting cools equally all over. The toughened glass is found to be almost as strong as iron, and it possesses greater durability. Mr. Bucknall, C.E., proposes to make the sleepers out of blast-furnace slag, under Mr. Buckley Bullan's process combined with the toughening process of Mr. Siemens.

At the Meeting of the Academy of Sciences on October 13th, M. Berthelot explained the plan of his new work "Essay on Chemical Mechanics founded upon Thermo-Chemistry." The first volume of this work is devoted to calorimetry. The second volume comprises the general study of chemical composition and decomposition. The remainder of the work is devoted to chemical statics.

A new manure is proposed by M. de Molon. Finely-ground phosphate of lime is mixed with sea-weeds, especially varec, the mass being allowed to ferment for six to eight weeks.

A statement is quoted in "Les Mondes" of October 2nd, from the New York "Popular Science Monthly," that a Boston chemist found in a sample of cream of tartar 75 per cent of *terra*

alba, and that at Chicago, a chemist, in want of antimony sulphide, could find in the shops merely marble-dust blackened with soot.

Metallurgy, Mineralogy, Mining, &c

In a recent report of the proceedings of the Manchester Literary and Philosophical Society there is a description, by Charles A. Burghardt, Ph.D., of a precious garnet (almandine) from Ramsbottom, Lancashire. Dr. Burghardt was asked to examine certain red granules present in a small specimen of rock, in order to ascertain whether they were garnets or not. The rock itself is a conglomerate of milky quartz grains, cemented together with silica and calcium carbonate; and disseminated throughout this conglomerate are the garnet grains in question, the whole constituting a 14-feet "fault" in the coal-seam known as the Sand-rock or Feather-edge Seam in the "Shipperbottom Mine," near Grant's Tower at Ramsbottom. A microscopical examination of the rock showed the garnets to be very irregular in form and to vary considerably in size, the largest attaining a width of about 2·25 m.m., and the smallest about 0·75 m.m. Both the garnets and the quartz grains could be extracted from the matrix, a cast of their forms being left behind. The red grains fused easily and quietly before the blowpipe to a black bead, which was not, however, magnetic: they were somewhat attacked by hydrochloric acid, with a slight separation of powdery silica; the presence of iron was also detected. The hardness of the mineral was 7·5, and its specific gravity 4·09 at 9° C. Dr. Burghardt hopes shortly to determine the chemical composition. A microscopical examination of the garnet grains showed them to be crystalline, exhibiting certain marked peculiarities, and after a careful examination of many of them he came to the conclusion that the form in which they crystallised was the rhombic dodecahedron. It is somewhat difficult to draw a conclusion as to the origin of these garnets in such a locality. From the microscopical examination of the rock it would appear that the cement and the garnets were *both* in a soft and pasty condition, the latter being probably formed whilst in the pasty matrix, and prevented from attaining a normal development. The quartz grains were probably formed previously to the garnets, as they appear to be waterworn pebbles, and were most likely carried along with the semi-paste-like mass which contained the constituents of garnet and calcite in its substance. When the paste hardened, the quartz grains and the garnets were enclosed in the manner exhibited on the specimen of rock from Ramsbottom. All the constituents of garnet were at hand, namely, aluminous shale, which would furnish the alumina and silica, and iron pyrites, which would furnish the iron, whilst water impregnated with calcium carbonate, acting upon the shale

and iron pyrites, would bring about the necessary chemical changes, calcium sulphate being formed and carried away, and the garnet solution could then crystallise out. Another explanation of the occurrence of garnet in the conglomerate may be as follows:—Garnet is a very common accessory of crystalline rocks, occurring mostly in slates of various kinds, such as talc slate, mica slate, chloritic slate, and aluminous slate; it also occurs in gneiss, granite, porphyry, serpentine, and granular limestone. One or more of the above-mentioned rocks containing crystallised garnets already formed were disintegrated by the action of water, and the resulting *débris* (consisting of grains or pebbles of quartz and garnets) was carried away and deposited in a semi-fluid mass of silica and calcite, and thus cemented together

Mr. F. P. Venable, of the University of Virginia, has analysed an alloy known as "Tungsten-Manganese Bronze." A fragment cut from a small block of so-called tungsten-manganese bronze, of light gold-yellow colour, pretty close grain, and with a fine polish upon one side of the specimen (sp. gr. = 8·64), was carefully tested qualitatively, and the proportion of the constituents found were thus determined. No manganese whatever was present, and but an insignificant amount of tungsten. The alloy consisted of—Cu, 86·51; Sn, 9·04; Zn, 3·47; Fe, 0·26; W, 0·23; total, 99·51. It is therefore but an ordinary gun-metal, with part of the tin replaced by zinc. Of course manganese may have been added in its production, as well as a larger proportion of tungsten; but if so, they have failed to be taken up, or have been burnt out before the alloy was cast; and manganese so removed may have served in a measure to improve the compactness and homogeneity of the mass by carrying off with it oxygen from the remaining metals, as in the use of phosphorus in making "phosphor-bronze." But the name under which the alloy is sold is calculated to mislead purchasers.

Barff's process for the prevention of corrosion on iron surfaces is being applied on a very large scale. The process, shortly, consists of passing superheated steam over the iron goods to be treated whilst at a red-heat, and can be applied to all kinds of iron-work, rendering it absolutely rustless at a less cost than galvanising, so substituting an absolute protection for one which confessedly is but partial in its action and easily removed.

From the Annual Report by the Keeper of Mining Records we learn that the production of coal in the United Kingdom during 1878 was estimated at 132,607,866 tons, valued at £46,412,753. The quantity of iron ore is given as 15,726,370 tons, valued at £5,609,507. There were produced 29,867 tons of iron pyrites, worth £19,099. Of pig-iron there were 6,381,051 tons produced from ores obtained in the United Kingdom, valued at £16,154,992. The total decrease in the production of coal in the year 1878, as

compared with that of 1877, was 1,955,876 tons. The production of pig-iron in Germany during 1878 was 2,124,444 metr. tons; zinc, 94,954; lead, 84,372; copper, 9541; tin, 831; antimony, 1245; coal, 39,429,308; lignite, 10,971,117; asphalte, 47,329. The total amount of pig-iron produced in France in 1878 was, according to "Engineering," 1,508,246 tons, most of which came from the Meurthe-et-Moselle. Pig produced with the aid of coke is greatly in demand, and is driving out charcoal pig and mixed sorts.

An attempt is contemplated to work coal-mines in the neighbourhood of Ching-men-Chow, not far from Tchang. Boring operations were commenced late last autumn. The coal-producing country appears to cover an extent of 758 square English miles, 15 long by 5 broad. There are two layers of coal, one above the other. It is supposed that 1,200,000 tons of coal can be raised from Wotzukow, and 800,000 from San-li-kang, at the rate of 40,000 tons a year. The supply thus would last at least forty years. It is highly probable that further explorations will bring to light fresh beds, as these discoveries are the result of merely the first investigations. Specimens of all the native and foreign coal procurable in China have been analysed together, and the new coal has shown itself superior to all for smelting purposes.

Requiring large quantities of platinum for his electro-chemical telephone, Mr. Edison issued, some few weeks ago, a circular letter of enquiry with regard to the possible occurrence of platinum in various parts of the United States. From the "Scientific American" we learn that Mr. Edison received some three thousand replies to his letter. Platinum, instead of being an extremely rare metal, seems to be widely distributed, and to occur in considerable abundance. It is found where gold occurs, and Mr. Edison thinks he can get 3000 lbs. a year from Chinese miners in one locality. One gravel-heap is mentioned from which a million ounces of platinum are expected!

Physics.

Since the Lontin electric light was first used at the Gaiety Theatre several important improvements have been effected. The improved machine possesses three advantages, viz.—the low speed at which it works, thus reducing wear and tear, risk of accidents, and overheating; the ready division of the light; and the production of alternate currents. The number of different circuits which one machine can generate, and the number of separate lights obtainable from each circuit, are, it is said, only limited by the size of the machinery. The machines now in operation at the Aldersgate Street Station of the Metropolitan

Railway have been constructed by Messrs. Harding and Co., of Paris. The generator works at a speed of 400 revolutions a minute, and the inductor at half that number. The motive power is supplied by a Fowler 25 horse-power high-pressure compound engine, capable of working up to 60 horse-power, which will probably also be used for producing electric lights in the Metropolitan Meat-market and at other stations on the Metropolitan Railway. The cost of coal and carbons is reckoned at less than 3d. per hour for a lamp equal in lighting-power to 600 candles, with an expenditure of from 1 to 1¼ horse-power. The lamp employed is the Serrin-Lontin, and by the most recent improvement the carbons will only require renewing once in fifteen hours. A great advantage is that the lamps can be lighted or extinguished independently of each other. The experiments at the Aldersgate Street Station are being carried out by the Electric Generator and Light Company. The first evening this light was exhibited, Mr. Harding, of Paris, explained the progress and capabilities of the Lontin system. "The most interesting news on this subject is,"—remarks the "Telegraphic Journal,"—"the statement made by Mr. Harding, at the exhibition of the Lontin light, to the effect that Mr. Crookes is engaged on some experiments with the electric light *in vacuo*, which promise to work an entire revolution in the prospects of the light. Carbons would be dispensed with, and the lamp would consist of a luminous globe, giving the light of (say) three candles. Thirty of these lamps would, it was thought, be maintained by an expenditure of 1¼ horse-power, at a cost of less than a penny per hour. We have always believed that there was something to be made by some one, in the way of electric lighting, out of Mr. Crookes's researches *in vacuo*, and we are gratified to hear that that eminent physicist is so near success himself. Mr. Edison and he are trenching upon the same ground with vacuo; but whereas the former uses metal electropyres, the latter uses none. Both are on the proper track, it seems to us, namely, the production of a perfectly steady light without any wasting of carbons or other perishable parts."

The Siemens electric light is now employed in the Reading Room of the British Museum. The main difference between the method adopted by Messrs. Siemens and that experimented upon some time ago by the Société Générale d'Electricité consists in the use of four very powerful lamps hung high over the heads of the readers, instead of a number of less powerful lights at a lower elevation. These four lights are produced by continuous currents passing through wires carried over the roof of the Reading Room and through the top of the glass lantern in the centre of the dome. The electricity is supplied by five dynamo-electric machines placed in a shed at the back of the Museum buildings at about 200 yards distance, and worked from two 8-horse-power semi-stationary engines, supplied by Messrs. Wallis and

Steevens, of Basingstoke. The regulators are the invention of Messrs. Siemens and Halske, of Berlin. They each contain 19 inches of double carbon, which are consumed at the rate of 3 inches an hour. The lights consequently will burn for a little more than six hours without the regulators being interfered with. Seven other lights, of which two are placed in the Court Yard, one under the portico, one in the Hall, one in the passage leading to the Reading Room, and the remaining two in the engine house, are worked by two alternate current machines, and the regulators are actuated by two coils acting on a differential principle, one of them forming part of the main circuit and tending to separate the carbons, the other tending to bring them into contact. The position of the carbons depends therefore not upon the strength of the current, but upon the relative amount of electricity passing through each coil. The carbons burn for about five hours, and may be renewed in half a minute. The wires supplying the current for these regulators are laid partly in the basement of the building, and partly in pipes under the ground. The light given out by each of these lamps is equal to 600 candles, and their steadiness says much for the excellence of the principle upon which they are constructed. The powers of the light were severely tested by several of the gentlemen present. Mr. George Bullen, Keeper of the Printed Books, put it to several practical working tests in different parts of the room, and found that at the desks which are farthest from the centre there was a decided lack of light for those who, like Mr. Bullen, have somewhat impaired their sight by incessant literary labour, while at the catalogue desks and in the centre of the room, the light was much more than sufficient to read even the smallest print. The diameter of the Reading Room it will be remembered is exactly 140 feet, the half of which is 70 feet. As at present placed the three outer lamps hang at a distance of about 35 feet from the centre, and of course at an equal distance from the wall. A moment's consideration will show that according to this arrangement the central portion of the room gets an overplus of light, while the part near the wall is underlighted. Mr. Bullen consequently suggested that the three outer lamps should be hung at a distance from the centre of two-thirds of the radius of the circle, by which means each third of the line between the centre and the circumference would be equally illuminated. By moving the outer lamps nearer the wall the outer row of the catalogues will be taken out of the deep shadow in which they were thrown by the arrangement adopted on Monday. Dr. Carter Blake submitted the purity of the light to some very searching colour-tests, and found that the most delicate tints were as easily distinguishable as in bright daylight.

In his excellent lecture on "Electricity as a Motive Power," delivered to the working men at Sheffield during the Meeting of the British Association, Prof. W. E. Ayrton demonstrated that a

dynamo-electric machine, with a separate exciter, driven very fast with a steam-engine, or with a stream of water, at high or low pressure, and sending, by even quite a fine wire, a small current to a distant electro-motor, also running very fast and magnetised by a separate exciter, is an economic arrangement for the transmission of power. As an illustration of what had been done by electricity as a motive power, Prof. Ayrton referred to the experiments of MM. Chrétien and Felix, who last year at Sermaize (Marne) ploughed fields by electricity, the electric current being produced by two of Gramme's dynamo-electric machines. These machines were usually worked with a steam-engine at some convenient place 300 or 400 yards away, in an adjoining road. The electro-motors were also two Gramme machines, one on each side of the field, with their coils revolving backwards. Through one of these the electric current was sent alternately, so that motion was given to one or other of two large windlasses, one on each of the waggons containing the electro-motors. In this way the plough, which could be used going in either direction, was first pulled across the field, making a furrow, and then back again, making another parallel furrow. M. Chrétien's electric crane has also been successfully employed for several months at Sermaize, in the harbour there, and it is considered that a saving of about 30 per cent has been effected of the expense formerly incurred for unloading the sugar-barrels out of the boats. Calculation showed that if electric currents—generated by very large steam-engines at certain points, and by turbines driven by the falling water on the hill-sides around Sheffield—were substituted for the use of coal for motive power, smelting, heating and lighting buildings, that a saving of something like £400,000 a year might be anticipated for that town. During the lecture electric lights, fed from a distance, were used. The current from a dynamo-machine at the works of Messrs. Walker and Hall, a considerable distance from the lecture-room, also set in motion an electro-motor on the platform. This in turn caused another dynamo-machine to rotate rapidly and produce a current with which the lecturer gilded a piece of plate. It was also shown that the Sheffield Water Company had a considerable surplus supply of water which could be used for producing motive power; and as an illustration of such a use of the water-power, a 2-inch board was sawn on the platform by a circular saw driven by an electric current generated by a water-engine in the yard of the Water Works, and conveyed to the hall by wires crossing the streets. In referring to the fact that electricity can produce not only motive power, but also light and heat, Prof. Ayrton said that Dr. Siemens had been able to effect a saving of about 30s. an hour, at the Royal Albert Hall, by replacing the old gas jets by electric lamps. The science of hanging a brilliant light high up had been luckily allowed to ride over the precedent of putting a number of feeble glimmers all over the building.

A new thermo-electric battery has been invented by M. Clamond for the production of the electric light. With a consumption of 9½ kilos. coke, a current is produced capable of maintaining four lamps, each equal to twenty-five Carcel burners.

In the American "Quarterly Microscopical Journal" Mr. F. H. Wenham gives some useful information relating to practical methods of obtaining parabolic forms. The mode of forming the template is simple and ingenious:—A cone of hard wood or metal is turned, removed from its centre, and fastened by one of its sides on a suitable chuck; a section is made in the lathe parallel to the attached side; a piece of accurately flattened brass, somewhat larger than the section, is fixed to the portion of the cone by screws, and above that a piece of similar material to that from which the cone was turned; it is then returned to its centre, and the cone turned down to its original form: the metal plate has its edges finished by holding to it a "dead smooth file." The cone is unscrewed, and the brass plate comes out a true parabola. The block of glass is turned with an old saw file and plenty of turpentine until it approximately fits the template; the paraboloid is then turned with a keen edge until the template, smeared with reddle and oil, marks it evenly all over; the marks are ground out with a small block of brass and emery of graduated fineness, until all scratches disappear. The glass is polished with a buff stick and crocus and water, and finally a piece of hard bees' wax is held against it, with finer crocus, to obtain the last degree of polish. If the paraboloid be a non-immersion one, with a cupped top, it may be turned flat on the end until the required thickness is arrived at, and the hemispherical cavity roughly turned out to a half-circle template till the centre is brought to the focus: the cavity is then finished in the same way as a concave lens. Finally, when rotatory in the lathe, the paraboloid is perforated through the axis with a steel drill and turpentine.

A new "Catalogue of Electric Apparatus" has been issued by Mr. E. Paterson, Bedford Court, Covent Garden. This Catalogue has the double merit of being copious and well illustrated with nearly 160 woodcuts. The first part contains a priced list of apparatus used for instruction and demonstration, while the second deals entirely with practical matter or applied electricity. In the second part a clear description is given of the construction of electrical apparatus intended for house signalling, bells, telegraphing short distances, &c. The telephone and electric lamp are also described. The directions given for fixing electric house-bells are sufficiently clear and devoid of technicalities to be of service to any ordinarily intelligent builder or bellhanger.

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